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(71) Applicant: **FUJI XEROX CO., LTD.**  
**Minato-ku, Tokyo (JP)**

(72) Inventors:  
• **Nakagaki, Juhei, c/o Fuji Xerox Co., Ltd.**  
**Hodogaya-ku, Yokohama-shi, Kanagawa (JP)**

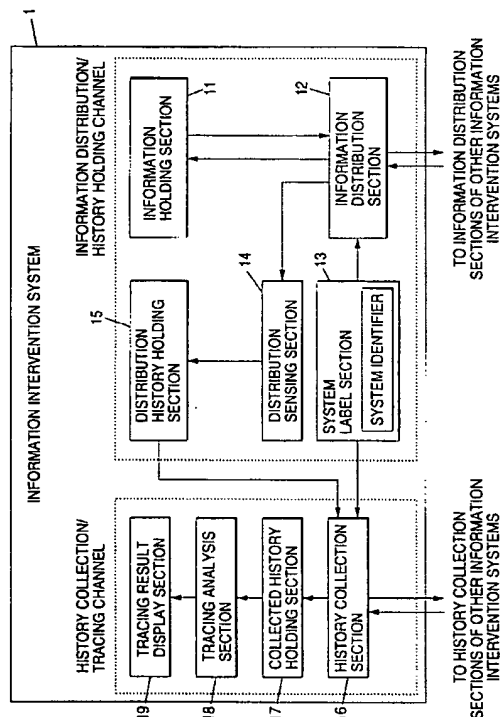
• **Saito, Kazuo, c/o Fuji Xerox Co., Ltd.**  
**Hodogaya-ku, Yokohama-shi, Kanagawa (JP)**  
• **Toju, Yasuko, c/o Fuji Xerox Co., Ltd.**  
**Hodogaya-ku, Yokohama-shi, Kanagawa (JP)**  
• **Kamibayashi, Noriyuki, c/o Fuji Xerox Co., Ltd.**  
**Hodogaya-ku, Yokohama-shi, Kanagawa (JP)**

(74) Representative: **Boeters, Hans Dietrich, Dr. et al**  
**Patentanwälte Boeters & Bauer,**  
**Bereiteranger 15**  
**81541 München (DE)**

## (54) Information tracing system and information tracing method

(57) An information processing system of the present invention records information on distribution when information is distributed so that an information distribution route is traced later. In the information processing system, when information held in an information holding section is distributed from an information distribution section to a different information intervention system, a distribution sensing section senses it and records its distribution history in a distribution history holding section. When an information tracing instruction is given, a history collection section fetches distribution histories related to the information to be traced from the distribution history holding section, detects the destination, and instructs the destination information intervention system to trace the information. In response to the instruction, history information is collected from the different information intervention system and is stored in a collected history holding section. A tracing analysis section analyzes the collected history information and displays the distribution route, etc., on a tracing result display section.

FIG. 1



EP 0 745 937 A2

## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to an information processing method and an information processing system capable of tracing distribution information of an information distribution route, distribution range, distribution amount, etc.

#### 2. Description of the Related Art

By the digital information technology development and the information highway initiative and the like, it will be soon accomplished that all information is digitalized and distributed through networks. Distribution of various pieces of information such as images, moving pictures, voice, and programs as well as text information has already begun through network media such as internets and personal computer communication. Although information originators or issuers and receivers are distinguished clearly from each other with information media like conventional broadcasting, in such a system, all users may be both information originators (issuers) and receivers. Therefore, anyone can readily distribute various pieces of information in various forms. Digitalized information, which has a feature of easy copying, is distributed via a number of persons; it is distributed among the users who copy and redistribute the information, and the information distribution range and speed will be accelerated.

Under such circumstances, a situation in which once information is left from a person, how it is passed to and used by what person is unknown occurs. Each person may want to know whether or not once distributed information has been passed to his or her intended person, what point the information has been distributed to on the distribution route, what route the information has been distributed through, etc. Further, recently, programs into which computer viruses are mixed, information containing a violation of privacy, and the like have often been distributed illegally without recognition. When such illegal information is distributed, a demand for specifying the originator or issuer and the distribution route of the information also occurs. However, in the conventional art, such demands cannot fully be solved and some demands are only solved.

For example, in an electronic mail communication network described in Unexamined Japanese Patent Publication (kokai) No. Hei 4-268849, at the node receiving electronic mail, information concerning the originator name and passed-through node added to the received electronic mail can be compared with information concerning the network configuration held in the node to see if the electronic mail originator name is false. Further, in transfer of electronic mail, the transmitter pre-

pares transmission and reception logs together with information to be sent to the receiver and transfers both as a unit to the receiver.

However, in the electronic mail communication network, the passed-through node route when information is transmitted from one user A to another B is only recorded and when the information is further transmitted from user B to user C, user A information is not left. Thus, the function cannot be used for tracing across the users. Since the electronic mail communication network depends on a specific feature of electronic mail, for example, if information is simply copied from a storage of one person to a storage of another person, the route of distribution (in this case, copy) of the information is not recorded and the distribution route of the information cannot be known later. Further, for example, when the transmitter wants to know what point his or her transmitted information reaches at present, he or she cannot trace it.

In an office information processing system described in Unexamined Japanese Patent Publication (kokai) No. Hei 5-63728, control information indicating what processing can be performed after reception is added to electronic mail and history information on operation performed on received mail is stored. By referencing the history information, the transmitter can know whether or not transmitted electronic mail has been processed, for example. However, in the system, what route the information has been distributed through cannot be known although the originator of received electronic mail can be known. Like the above-mentioned electronic mail system, the office information processing system does not consider any distribution route other than the electronic mail system. Thus, in the office information processing system, the distribution route of received information cannot be known.

Further, in an electronic document preparation/approval system with an electronic certification function described in Unexamined Japanese Patent Publication No. Hei 2-297288, certification data created by a certification process at approval is registered in a certification logging file, thereby enabling a document approval state to be traced. Since the electronic document preparation/approval system enables the approval requester to know the current approval state, even if a document is distributed to a person who does not perform an approval process, the fact cannot be known. As with the electronic mail communication network, if information not related to approval is simply copied from a storage of one person to a storage of another person, the route of distribution (in this case, copy) of the information is not recorded and the distribution route of the information cannot be known later.

As we have discussed, without using a special system such as the electronic mail or approval system, when various kinds of information are distributed by various methods through various persons, once distributed information cannot be traced to its distribution route and

when illegal information is distributed, the originator (issuer) and distribution route of the information cannot be located either.

### SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide an information processing method and an information processing system for recording information on distribution when information is distributed, thereby enabling an information distribution route to be traced later.

An information tracing system of the present invention is comprised of: distribution sensing unit for sensing information distribution from a first information processing system as an information distribution source to a second information processing system as an information distribution destination; a plurality of distribution history storing unit for storing histories related to information distribution sensed by the distribution sensing unit; history acquiring unit for acquiring the histories stored in other distribution history storing unit in response to the history stored in one of the distribution history storing unit; and analyzing unit for analyzing an information distribution route in response to the histories acquired by the history acquiring unit.

According to the present invention, information distribution from a distribution source to a destination is sensed, and information concerning distribution of the sensed information is stored. Information concerning any other related distribution is acquired based on the information concerning one distribution, and a distribution route is analyzed based on the acquired distribution information. The distribution route is a concept also containing the information transmission source, the transmission route, the distribution range, the distributed information amount, etc., whereby distribution information of information distribution, distribution route, distribution range, distribution amount, etc., can be traced later. At this time, the route can also be traced in the information transfer direction from the information transmission source and the information transfer route can also be traced from the information reception party to the transmission source. The route in the information transfer direction or toward the transmission source can also be traced at an intermediate point of the transfer route.

### BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawings:

Figure 1 is block diagrams to show a first embodiment of an information processing system of the invention;

Figure 2 is an illustration of an example of the format of information in the first embodiment of the information processing system of the invention;

Figure 3 is a hardware block diagram to show an example for providing the first embodiment of the

information processing system of the invention; Figure 4 is an illustration of an example of information flows in the first embodiment of the information processing system of the invention;

Figure 5 is a flowchart to show an example of processing in a source information intervention system when information is distributed in the first embodiment of the information processing system of the invention;

Figure 6 is a flowchart to show an example of processing in a destination information intervention system when information is distributed in the first embodiment of the information processing system of the invention;

Figure 7 is an illustration of an example of the information distribution operation in the first embodiment of the information processing system of the invention;

Figure 8 is an illustration of an example of distribution histories held in a distribution history holding section in the first embodiment of the information processing system of the invention;

Figure 9 is an illustration of an example after information distribution in the first embodiment of the information processing system of the invention;

Figure 10 is a flowchart to show an example of processing of a history collection section when information is traced in an information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention;

Figure 11 is a flowchart to show an example of processing of the tracing analysis section when information is traced in the information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention;

Figure 12 is a flowchart to show an example of processing of a history collection section when information is traced in any other information intervention system than the information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention;

Figure 13 is a flowchart (continued) to show an example of processing of a history collection section when information is traced in any other information intervention system than the information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention;

Figure 14 is an illustration of an example of the contents of the collected history holding section in the first embodiment of the information processing system of the invention;

Figure 15 is an illustration of an example of display of a tracing result display section in the first embodiment of the information processing system of the

invention;

Figure 16 is an illustration of an example of an information flow in a second embodiment of the information processing system of the invention;

Figure 17 is an illustration of an example of the information distribution operation in the second embodiment of the information processing system of the invention;

Figure 18 is an illustration of an example after information distribution in the second embodiment of the information processing system of the invention;

Figure 19 is an illustration of an example of display of a tracing result display section in the second embodiment of the information processing system of the invention;

Figure 20 is an illustration of an example of an information flow in a third embodiment of the information processing system of the invention;

Figure 21 is an illustration of an example after information distribution in the third embodiment of the information processing system of the invention;

Figure 22 is an illustration of an example of display of a tracing result display section in the third embodiment of the information processing system of the invention;

Figure 23 is block diagrams to show a fourth embodiment of the information processing system of the invention;

Figure 24 is an illustration of an example of an information flow in the fourth embodiment of the information processing system of the invention;

Figure 25 is an illustration of an example after information distribution in the fourth embodiment of the information processing system of the invention;

Figure 26 is an illustration of an example of the contents of a collected history holding section in the fourth embodiment of the information processing system of the invention;

Figure 27 is an illustration of an example of distribution route display of a tracing result display section in the fourth embodiment of the information processing system of the invention;

Figure 28 is an illustration of an example of preparation process display of the tracing result display section in the fourth embodiment of the information processing system of the invention;

Figure 29 is a block diagram to show the fifth embodiment of the information processing system of the invention;

Figure 30 is an illustration of an example of the format of information in the fifth embodiment of the information processing system of the invention;

Figure 31 is a block diagram to show a sixth embodiment of the information processing system of the invention;

Figure 32 is an illustration of an example of information flows in the sixth embodiment of the information processing system of the invention;

Figure 33 is an illustration of an example of display of a tracing result display section in the sixth embodiment of the information processing system of the invention;

Figure 34 is an illustration to show an example of the format of information when information is provided with a distribution history in a seventh embodiment of the information processing system of the invention;

Figure 35 is an illustration of an example of the information distribution operation when information is provided with a distribution history in the seventh embodiment of the information processing system of the invention;

Figure 36 is an illustration to show an example of the format of information when an information medium is provided with a distribution history in the seventh embodiment of the information processing system of the invention;

Figure 37 is an illustration of an example of the information distribution operation when an information medium is provided with a distribution history in the seventh embodiment of the information processing system of the invention; and

Figure 38 is an illustration of an example of the information distribution operation in an eighth embodiment of the information processing system of the invention.

## PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to the accompanying drawings, preferred embodiments of the present invention will be described.

First embodiment:

Figure 1 is block diagrams to show a first embodiment of an information processing system of the invention. In the figure, numeral 1 designates an information intervention system; 11, an information holding section; 12, an information distribution section; 13, a system label section; 14, a distribution sensing section; 15, a distribution history holding section; 16, a history collection section; 17, a collected history holding section; 18, a tracing analysis section; and 19, a tracing result display section.

The information intervention system 1, which intervenes in information transfer and distribution, has the information holding section 11, the information distribution section 12, the system label section 13, the distribution sensing section 14, the distribution history holding section 15, the history collection section 16, the collected history holding section 17, the tracing analysis section 18, and the tracing result display section 19.

The information intervention system 1 mentioned in the invention refers to a system for intervening in information transfer in a broad sense; specifically, it contains

not only a system dedicated to information transfer, such as a gateway in a network or an exchange in a telephone network, but also a system resultantly distributing information, such as an information processing system like a workstation or personal computer connected to a network. It also contains a mail server, etc., for distributing electronic mail on a network. Further, it contains an electronic information machine such as a disk drive for reading and writing information storage media such as hard disk or floppy disk; information copying, etc., between information storage media or within a single information storage medium corresponds to information distribution.

The information holding section 11 stores information processed by the information intervention system 1, for example, information to be distributed or distributed. In fact, it is made of a memory or a magnetic disk unit.

The information distribution section 12 exchanges information with other information intervention systems, whereby information can be distributed. For example, it is made up of a network interface, a modem, etc., for transmitting and receiving information to and from other information intervention systems via a network.

The system label section 13 holds a system identifier for uniquely identifying the information intervention system 1. The system identifier is given when the information intervention system is manufactured; it may be inhibited from being changed later, or when the system is constructed, a unique identifier may be given.

The distribution sensing section 14 always monitors to sense whether or not the information distribution section 12 exchanges information with another information intervention system. When the information distribution section 12 exchanges information, the distribution sensing section 14 senses information on the exchange and records it in the distribution history holding section 15 as a distribution history related to information distribution. For example, if the information distribution section 12 is made of a network interface, the information exchange can be sensed if the network interface is monitored. The information to be sensed includes the information identifier of transferred information, the associated transfer system identifier, the distribution time of day, and the like are to be sensed. In addition, the source/destination user identifier, the information type, etc., may be sensed and recorded. The distribution time of day may be specified with a timer or clock contained in each information intervention system 1.

The distribution history holding section 15 records distribution histories related to information distribution sensed by the distribution sensing section 14. For example, it is made of an external storage such as a magnetic disk unit or a memory. The held contents will be discussed later.

When a tracing instruction for one information is issued, the history collection section 16 reads the distribution histories related to the specified information from the distribution history holding section 15, and sends an

information tracing instruction to other information intervention systems based on the distribution histories. Further, it receives reports from the information intervention systems to which the instruction was sent, and stores the reports in the collected history holding section 17. If a tracing instruction is given from another information intervention system and information is traced, the history collection section 16 returns the tracing result to the information intervention system giving the tracing instruction. It can be made up of a network, a telephone line, a modem, etc., for example. However, it is not limited to them and any other means may be used if it can accomplish a similar purpose, needless to say. The history collection section 16 may share a part of the configuration of the network interface, modem, etc., with the information distribution system 12.

The collected history holding section 17 stores the distribution histories collected by the history collection section 16 from other information intervention systems. The collected distribution histories are stored together with the system identifiers of the systems from which the histories are collected, which will be described in detail later.

The tracing analysis section 18 analyzes the distribution histories collected from other information intervention systems and stored in the collected history holding section about the item specified by a command of the user, etc. It analyzes various pieces of information on distribution such as information transfer, distribution route, distribution range, etc., as to how information was distributed via which information intervention systems. A specific analysis algorithm will be described later.

The tracing result display section 19 produces output such as display of the analysis result of the tracing analysis section 18 in the format that can be understood by the user, etc. In the embodiment, the tracing result display section 19 is used for visualizing the analysis result of the trace information in the format that can be understood by human beings, but the invention is not limited to it. For example, if the analysis result is used by a computer, etc., for performing automatic processing, the tracing result display section can be replaced with another component.

Figure 2 is an illustration of an example of the format of information in the first embodiment of the information processing system of the invention. As shown in the drawing, the information has an information main body and an information label section for holding an information identifier to identify the information. The information main body is information having essential meanings and contains various kinds of information such as images, programs, texts, and moving pictures. The information label section contains the information identifier to uniquely identify the information. The information identifier may be any if it can distinguish the information from any other information, such as a label represented by a pair of machine name and file name as well as such an identifier represented by digits, etc.

Although the information label section is used for holding only the information identifier in the embodiment, generally it may store attributes concerning the information, such as the information creator and creation date. In such a system charging for the service in response to the use amount of information, information on the charge is also stored in the information label section. If only the information identifier is stored in the information label section, it may be attached to the information main body without providing the information label section. In any way, the information identifier or such information stored in the information label section has no meaning if it is separated from the information main body. Thus, generally it is encrypted so as not to be separated at the distribution time, for example.

Figure 3 is a hardware block diagram to show an example for providing the first embodiment of the information processing system of the invention. In the figure, 31 and 32 designate networks; 33, a terminal; 34, a server; 35, a gateway; 36, a CPU; 37, a disk; 38, an output unit; and 39, an input unit. The example shown in Figure 3 is made up of machines connected through some communication means, such as the terminals 33 of workstations, personal computers, etc., and the server 34 connected through communication means such as the networks 31 and 32 and the gateway 35 for connecting the networks. The terminals 33 are made of general workstations, personal computers, etc., each of which consists of a CPU 36, a disk 37, an output unit 38 such as a display, and an input unit such as a keyboard and a mouse. The server 34 and the gateway 35 are also general machines each consisting of a CPU 36, a disk 37, etc. The information intervention systems 1 can be related to all or some of the machines shown in Figure 3.

Next, the operation in the first embodiment of the information processing system of the invention will be described. Figure 4 is an illustration of an example of information flows in the first embodiment of the information processing system of the invention. It shows four information intervention systems A-D and gives an example in which information X is distributed from information intervention system A to information intervention system B from which the information X is distributed to information intervention systems C and D.

The information intervention system A senses distribution of the information X to the information intervention system B and records its distribution history in the distribution history holding section 15. Likewise, the information intervention system B senses distribution of the information X to the information intervention systems C and D and records two distribution histories in the distribution history holding section 15.

When an instruction for tracing the distribution route of the information X is given in the information intervention system A, the distribution history of the information X is fetched from the distribution history holding section 15 of the information intervention system A and the information intervention system B to which the information

X was distributed is instructed to trace the distribution route of the information X. Upon reception of the instruction for tracing the distribution route of the information X from the information intervention system A, the information intervention system B fetches the distribution history of the information X from its distribution history holding section 15 and instructs the information intervention systems C and D to which the information X was distributed to trace the distribution route of the information X. The information intervention systems C and D, which do not hold the distribution history of the information X, return a message to the effect that the distribution history related to the information X does not exist to the information intervention system A. The information intervention system B returns the distribution histories recorded when the information X was distributed to the information intervention systems C and D to the information intervention system A, whereby the information intervention system A can know that the information X was distributed as shown in Figure 4. Thus, the information intervention system A can analyze the distribution route, distribution range, etc., of the information X.

A processing flow as described above will be described in detail. First, the information distribution operation will be described. Figure 5 is a flowchart to show an example of processing in a source information intervention system when information is distributed in the first embodiment of the information processing system of the invention. At step S41, the source information intervention system assigns the system identifier of the destination information intervention system to variable M-to and the information identifier of the information to be distributed to variable X. Next, at step S42, the information distribution section 12 of the information intervention system A searches for the information intervention system having the system identifier equal to that stored in the variable M-to on the network and establishes a connection to the found information intervention system. At step S43, it reads the information having the information identifier equal to that stored in the variable X from the information holding section 11, and assigns the read information to variable InfoX. At step S44, the information distribution section 12 distributes the information stored in the variable InfoX to the information intervention system having the system identifier stored in the variable M-to. At step S45, the distribution sensing section 14 senses the distribution process and records a set of (X, M-to, Time), where Time denotes the distribution time of day, in the distribution history holding section 15 as a distribution history. The information distribution process in the source information intervention system is now complete.

Figure 6 is a flowchart to show an example of processing in a destination information intervention system when information is distributed in the first embodiment of the information processing system of the invention. First, at step S51, the destination information intervention system assigns the system identifier of the

source information intervention system making a connection establishing request for information distribution to variable M-from. Next, at step S52, the information distributed from the information intervention system having the system identifier stored in the variable M-from is assigned to variable InfoX. At step S53, the information distribution section 12 stores the information assigned to the variable InfoX in the information holding section 11. The information distribution process in the destination information intervention system is now complete.

Figure 7 is an illustration of an example of the information distribution operation in the first embodiment of the information processing system of the invention. An example of the operation shown in Figures 5 and 6 will be discussed based on a specific example. Here, distribution of information having information identifier id-X from information intervention system A to information intervention system B will be discussed. At this time, the source information intervention system is the information intervention system A and the destination information intervention system is the information intervention system B. Let the system identifiers of the information intervention systems A and B be id-A and id-B respectively. In the example shown in Figure 7, assume that the information holding section 11 of the information intervention system A stores information having information identifier id-X and information having information identifier id-Y.

First, processing in the source information intervention system A will be discussed with reference to Figures 5 and 7. In the example, the information intervention system A is going to distribute the information having the information identifier id-X to the information intervention system B, thus at step S41, it assigns the system identifier id-B of the destination information intervention system B to the variable M-to and the information identifier id-X of the information to be distributed to the variable X. Next, at step S42, the information distribution section 12 of the information intervention system A searches the network for the information intervention system B having the system identifier id-B and establishes a connection to the information distribution section 12 of the information intervention system B. At step S43, the information distribution section 12 of the information intervention system A reads the information having the information identifier id-X from the information holding section 11 and assigns the information to the variable InfoX. Further, at step S44, it distributes the information assigned to the variable InfoX to the information distribution section 12 of the information intervention system B. At step S45, the distribution sensing section 14 of the information intervention system A senses the distribution process and records a set of

(information identifier id-X, destination system identifier id-B, Time)

in the distribution history holding section 15 of the information intervention system A. In Figure 7, this record is

represented as

sent id-X to id-B at T1

where T1 is the distribution time of day. The record denotes that the information having the information identifier id-X was sent to the information intervention system having the information identifier id-B at the time T1. Thus, the information intervention system A distributes the information and records the distribution history in the distribution history holding section 15.

Next, processing in the destination information intervention system B will be discussed with reference to Figures 6 and 7. First, at step S51, upon reception of the connection establishing request from the information intervention system A at step S42 in Figure 5, the information intervention system B establishes a connection and assigns the system identifier id-A of the source information intervention system A to the variable M-from. Next, at step S52, the information distribution section 12 of the information intervention system B receives the information having the information identifier id-X distributed from the information distribution section 12 of the information intervention system A at step S44 in Figure 5, and assigns the information to the variable InfoX. At step S53, the information distribution section 12 of the information intervention system B stores the information assigned to the variable InfoX in the information holding section 11 of the information intervention system B. The process in which the information intervention system A distributes the information to the information intervention system B is now complete.

Figure 8 is an illustration of an example of distribution histories held in the distribution history holding section in the first embodiment of the information processing system of the invention. In Figure 7, the distribution history is, for example, shown as

sent id-X to id-B at T1

The actual contents recorded in the distribution history holding section 15 may be thus recorded as a character string, but can also be recorded as binary data. Figure 8 shows representation of a distribution history as binary data. The target information identifier corresponds to "id-X," the destination system identifier to "id-B," and the reception time to "T1."

One row in Figure 8 represents one distribution history. For example, the information on the top row means that information having information identifier "679840-176" was sent to information intervention system having identifier "800287" at 12 hours 9 minutes 4 seconds 41 on March 10, 1995. Each time one information is distributed, such a distribution history will be added to the distribution history holding section 15. In the description to follow, basically the representation

sent id-X to id-B at T1

is used for the history contents.

Figure 9 is an illustration of an example after information distribution in the first embodiment of the information processing system of the invention. As described above, the information having the information

identifier id-X was distributed from the information intervention system A to the information intervention system B. After this, if the information flows, for example, as shown in Figure 4, it is furthermore distributed from the information intervention system B to the information intervention systems C and D. Figure 9 shows the distribution history holding sections 15 of the information intervention systems A-D after the information is distributed as shown in Figure 4. Here, the system identifiers of the information intervention systems C and D are id-C and id-D respectively. Figure 9 shows only a part of the configuration in each information intervention system.

As in the information distribution process from the information intervention system A to the information intervention system B, the information is distributed from the information intervention system B to the information intervention system C. Resultantly, the distribution history

sent id-X to id-C at T2

is recorded in the distribution history holding section 15 of the information intervention system B. Likewise, the information is distributed from the information intervention system B to the information intervention system D and resultantly, the distribution history

sent id-X to id-D at T3

is recorded in the distribution history holding section 15 of the information intervention system B. Thus, each time information is distributed, its distribution history is recorded in the distribution history holding section 15 of the source information intervention system.

Next, information tracing processing will be discussed. Figure 10 is a flowchart to show an example of processing of the history collection section when information is traced in an information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention. Now, when an information transfer and distribution route tracing instruction is given in one information intervention system, first at step S61 the history collection section 16 gets the system identifier of the home information intervention system which starts tracing from the system label section 13 and assigns the system identifier to variable M-first. It also assigns the information identifier of the information to be traced to variable X. Further, it generates id for distinguishing this tracing from another tracing and assigns it to variable Q-id, which is used to identify tracing instructions to avoid an instruction loop when the information intervention systems communicate with each other. If there is no loop possibility or an alternative method can be used, the variable Q-id need not be used.

Next, at step S62, the history collection section 16 reads the distribution histories related to the information identifier assigned to the variable X from the distribution history holding section 15 and assigns the distribution history to variable History. At S63, whether or not the variable History is null is checked. If it is null, control

goes to step S68; if not null, control goes to step S64.

At step S64, one history information entry is fetched from the variable History and is assigned to variable H1. As described above, the history information contains sets of (information identifier, destination system identifier, distribution time) and such a set is also assigned to the variable H1. At step S65, from the variable H1, the destination system identifier is fetched and assigned to variable M-to and the distribution time is fetched and assigned to variable Time. At step S66, the history collection section 16 instructs the history collection section 16 of the information intervention system indicated by the system identifier assigned to the variable M-to to perform process TRACE and notify M-first. The process TRACE is a process shown in flowcharts in Figures 12 and 13 discussed later. It is executed in other information intervention systems than the information intervention system starting the tracing. Since the home system identifier is assigned to the variable M-first, the instruction requests the process TRACE execution result to be returned to the home information intervention system. At step S67, the history collection section 16 stores (variable M-first, variable H1) pair in the collected history holding section 17 and moves the distribution history recorded in the home distribution history holding section 15 to the collected history holding section 17. Then, control returns to step S63.

If the variable History is null at step S63, the tracing instruction process of the history collection section 16 in the information intervention system starting the tracing is terminated; after this, the history collection section 16 stores tracing reports sent from other systems in the collected history holding section 17 one after another at step S68.

Figure 11 is a flowchart to show an example of processing of the tracing analysis section when information is traced in the information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention. The tracing analysis section 18 operates subsequently to the processing of the history collection section 16. Here, processing after all reports for the instruction issued by the history collection section 16 to any other information intervention system are returned will be discussed.

First, at step S71, the tracing analysis section 18 assigns the information identifier of the information to be traced to variable X. Next, at step S72, it reads the history information related to the information identifier assigned to the variable X from the collected history holding section 17, and assigns the history information to variable History2. At step S73, whether or not the variable History2 is null is checked. If it is null, control goes to step S79; if not null, control goes to step S74.

At step S74, nodes corresponding to the system identifiers of the source systems of all history information contained in the variable History2 are prepared. At step S75, whether or not the variable History2 is null is



checked. If it is null, control goes to step S79; if not null, control goes to step S76. At step S76, one history information entry is fetched from the variable History2 and is assigned to variable H2. At step S77, the source system identifier, destination system identifier, and time in the variable H2 are assigned to variables M-from, M-to, and Time respectively. At step S78, an arc from the node of variable M-from to the node of variable M-to is prepared. Then, control returns to step S75.

If the variable History2 is null at step S73 or S75, a prepared tracing route chart is displayed on the tracing result display section 19 at step S79.

Figures 12 and 13 are a flowchart to show an example of processing of the history collection section when information is traced in any other information intervention system than the information intervention system which starts information tracing processing in the first embodiment of the information processing system of the invention. This processing is the TRACE process whose execution instruction is given by the information intervention system starting the tracing at step S66 in the flowchart shown in Figure 10. A TRACE process execution instruction is given to another information intervention system from within the TRACE process.

Upon reception of a tracing instruction from a different information intervention system, first at step S81, the history collection section 16 assigns initial values to variables as follows: The system identifier of the information intervention system starting the tracing to variable M-first, the system identifier of the information intervention system giving the tracing instruction to variable M-from, the system identifier of the home information intervention system to variable M-me, the information identifier of the information to be traced to variable X, id of the tracing instruction to variable Q-id, and null to variable Result. At step S82, if the same id as the id assigned to the variable Q-id exists in the collected history holding section 17, the instruction loops, thus the process is terminated. At step S83, the history collection section 16 reads the distribution histories related to the information identifier assigned to the variable X from the distribution history holding section 15 and assigns the distribution history to variable History. At S84, whether or not the variable History is null is checked. If it is null, control goes to step S90; if not null, control goes to step S85.

At step S85, one history information entry is fetched from the variable History and is assigned to variable H1. At step S86, the destination system identifier in the variable H1 is assigned to variable M-to and the time in the variable H1 is assigned to variable Time. At step S87, the information intervention system indicated by the system identifier assigned to the variable M-to is instructed to perform process TRACE and notify M-first. This instruction requests the history collection section 16 of the destination information intervention system to execute process TRACE and return the result to the information intervention system starting the tracing. At step S88,

(variable M-me, variable H1) pair is added to the variable Result, whereby the distribution history recorded in the distribution history holding section 15 is added as the information to be returned to the information intervention system starting the tracing. At step S89, whether or not the variable History is null is checked. If it is null, control goes to step S91; if not null, control returns to step S85.

If the variable History is null at step S84, it indicates that the information is not distributed to any information intervention systems following the information intervention system. In this case, at step S90, (variable M-me, null) pair is transmitted to the variable M-first of the information intervention system giving the TRACE process execution instruction.

If the variable History is null at step S89, namely, processing for the history information stored in the variable History is complete at steps 85-88, a home system identifier and history information pair list is stored in the variable Result. At step S91, the contents of the variable Result of the TRACE process execution result are transmitted to the information intervention system starting the tracing assigned to the variable M-first.

To indicate completion of processing for the tracing instruction at step S92 following steps S90 and S91, the id of the tracing instruction assigned to the variable Q-id is stored in the collected history holding section 17. The process TRACE of the history collection section 16 in any other information intervention system than the information intervention system starting information tracing processing is now complete.

The information tracing processing described above will be discussed with the specific example shown in Figure 9. As previously discussed, Figure 9 shows the contents of the distribution history holding sections 15 of the information intervention systems after distribution of the information having the information identifier id-X from the information intervention system A to the information intervention system B and from the information intervention system B to the information intervention systems C and D. In the example, assume that an instruction is given for tracing the information having the information identifier id-X from the information intervention system A. In this case, the history collection section 16 of the information intervention system A performs the processing shown in Figure 10 described above, the tracing analysis section 18 of the information intervention system A performs the processing shown in Figure 11 described above, and the tracing analysis sections 16 of the information intervention systems B, C, and D perform the processing shown in Figure 12 described above.

The transfer and distribution route tracing processing flow of the information having the information identifier id-X from the information intervention system A is as follows: First, the processing of the history collection section 16 in the information intervention system A starting the tracing will be discussed with reference to Fig-

ures 9 and 10.

When an instruction for tracing the transfer and distribution route of the information having the information identifier id-X is issued in the information intervention system A, first at step S61, the history collection section 16 of the information intervention system A assigns the system identifier id-A of the home information intervention system starting the tracing to the variable M-first and the information identifier of the information to be traced, id-X, to the variable X. Here, assuming that id "A0001" is prepared, the id of the tracing instruction is assigned to the variable Q-id.

At step S62, the history collection section 16 of the information intervention system A reads the distribution histories related to the information identifier id-X assigned to the variable X from the distribution histories stored in the distribution history collection section 15. In the example, only one distribution history related to the information identifier id-X

sent id-X to id-B at T1

is found. This distribution history is assigned to the variable History. At step S63, whether or not the variable History is null is checked. Since it is not null, control goes to step S64.

At step S64, one history information entry is fetched from the variable History. In the example, the distribution history

sent id-X to id-B at T1

is fetched and assigned to the variable H1. This distribution history indicates that the information having the information identifier id-X was distributed to the information intervention system having the system identifier id-B at the time T1. The variable History from which the history information is fetched becomes null. At step S65, from the variable H1, the destination system identifier id-B is assigned to the variable M-to and the time T1 is assigned to the variable Time.

At step S66, the history collection section 16 of the information intervention system A instructs the history collection section 16 of the information intervention system having the system identifier id-B, namely, the information intervention system B to perform process TRACE and notify M-first. Since the system identifier id-A of the information intervention system A is stored in the variable M-first, the instruction requests the history collection section 16 of the information intervention system B to trace the transfer and distribution route of the information having the information identifier id-X following the information intervention system B and return a report of the tracing result to the information intervention system A.

At step S67, the history collection section 16 of the information intervention system A stores the following (variable M-first, variable H1) pair:

(id-A, sent id-X to id-B at time T1)

in the collected history holding section 17. Then, control returns to step S63.

When control returns to step S63, the variable His-

tory is null, thus the condition at step S63 "variable History = null" is true. Then, control goes to step S68 at which the history collection section 16 of the information intervention system A stores the reports concerning the tracing sent from the information intervention system B in the collected history holding section 17 one after another.

Next, the processing of the history collection sections 16 in other information intervention systems than the information intervention system A starting the tracing will be discussed with reference to Figures 9 and 12. At step S66, the history collection section 16 of the information intervention system A instructed the history collection section 16 of the information intervention system B to perform the process TRACE and notify M-first. The history collection section 16 of the information intervention system B executes the process TRACE shown in Figure 12 in response to the instruction.

The history collection section 16 of the information intervention system B, which receives the tracing instruction from the history collection section 16 of the information intervention system A, initializes the variables at step S81 as follows: The system identifier of the information intervention system A starting the tracing, id-A, is assigned to the variable M-first and the system identifier of the information intervention system A giving the tracing instruction, id-A, is assigned to the variable M-from. In this example, the tracing starting system and the instruction giving system happen to be the same; generally, different values are assigned to the variables. Further, the system identifier of the home information intervention system B, id-B, is assigned to the variable M-me, the information identifier of the information to be traced, id-X, to the variable X, the id of the tracing instruction, "A0001," to the variable Q-id, and null to the variable Result.

At step S82, whether or not the same id as the id "A0001" of the tracing instruction assigned to the variable Q-id exists in the collected history holding section 17 is determined. In the example, the same tracing instruction id does not exist in the collected history holding section 17 and control goes to the following step.

At step S83, the history collection section 16 of the information intervention system B reads the distribution histories related to the information identifier id-X from the distribution history holding section 15. As shown in Figure 9, two distribution histories related to the information identifier id-X are stored in the distribution history holding section 15 of the information intervention system B. The history collection section 16 reads the two distribution histories and assigns them to the variable History. Now, the following distribution histories are stored in the variable History:

sent id-X to id-C at T2

sent id-X to id-D at T3

At S84, whether or not the variable History is null is checked. Since it is not null, control goes to step S85 at which one distribution history is fetched from the varia-

ble History and is assigned to the variable H1. Here, assume that

sent id-X to id-C at T2

is fetched and assigned to the variable H1. The fetched distribution history is deleted from the variable History. At step S86, the destination system identifier id-C in the variable H1 is assigned to the variable M-to and T2 is assigned to the variable Time.

At step S87, the history collection section 16 of the information intervention system B instructs the history collection section 16 of the information intervention system having the destination system identifier id-C assigned to the variable M-to, namely, the information intervention system C to perform process TRACE and notify M-first. Since the system identifier id-A of the information intervention system A is stored in the variable M-first, the instruction requests the history collection section 16 of the information intervention system C to trace the transfer and distribution route of the information having the information identifier id-X following the information intervention system C and return a report of the tracing result to the information intervention system A.

At step S88, the (variable M-me, variable H1) pair, namely, (id-B, (sent id-X to id-C at T2)) is added to the variable Result. At step S89, whether or not the variable History is null is checked. In this case, it is not null, and control returns to step S85.

At step S85, one distribution history is fetched from the variable History and is assigned to the variable H1. Here,

sent id-X to id-D at T3

is fetched and assigned to the variable H1. The variable History becomes null. At step S86, the destination system identifier id-D in the variable H1 is assigned to the variable M-to and T3 is assigned to the variable Time.

At step S87, the history collection section 16 of the information intervention system B instructs the history collection section 16 of the information intervention system D to perform process TRACE and notify M-first. That is, the instruction requests the history collection section 16 of the information intervention system D to trace the transfer and distribution route of the information having the information identifier id-X following the information intervention system D and return a report of the tracing result to the information intervention system A.

At step S88, the pair

(id-B, (sent id-X to id-D at T3))

is added to the variable Result. At step S89, whether or not the variable History is null is checked. In this case, processing for all distribution histories in the variable History is complete and the variable History is null, thus control goes to step S91.

When control goes to step S91, the two information entries

(id-B, (sent id-X to id-C at T2)); and

(id-B, (sent id-X to id-D at T3))

are stored in the variable History. At step S91, the information is transmitted to the information intervention system having the system identifier id-A stored in the variable M-first, namely, the information intervention system A.

Last, to indicate completion of processing for the tracing instruction at step S92, the id "A0001" of the tracing instruction is stored in the collected history holding section 17. The process TRACE in the history collection section in the information intervention system B is now complete. In the example, after all, steps S85-S88 are repeated twice and the history collection section 16 of the information intervention system B instructs the history collection sections 16 of the information intervention systems C and D to trace the transfer and distribution route of the information having the information identifier id-X and return a report of the tracing result to the information intervention system A, and transmits the information

id-B: sent id-X to id-C at T2

id-B: sent id-X to id-D at T3

to the information intervention system A, then completes the process.

At step S87, the history collection section 16 of the information intervention system B instructed the history collection sections 16 of the information intervention systems C and D to perform the process TRACE and notify the information intervention system A. The history collection sections 16 of the information intervention systems C and D execute the process TRACE shown in Figure 12 in response to the instruction as the history collection section 16 of the information intervention system B does.

The history collection section 16 of the information intervention system C performs initialization at step S81 and checks the tracing instruction id at step S82, then attempts to read the distribution histories related to the information identifier id-X from the distribution history holding section 15 at step S83, but does not find any. Thus, the variable History becomes null. The determination at step S84 becomes true and control goes to step S90 at which the history collection section 16 transmits a pair of (M-me, null), for example,

id-C: null

to the information intervention system A, then completes the process.

Like the history collection section 16 of the information intervention system C, the history collection section 16 of the information intervention system D executes similar steps and transmits

id-D: null

to the information intervention system A, then completes the process.

Finally, from the information intervention systems B, C, and D, the following information

id-B: sent id-X to id-C at T2  
 id-B: sent id-X to id-D at T3  
 id-C: null  
 id-D: null

is sent to the information intervention system A.

Figure 14 is an illustration of an example of the contents of the collected history holding section in the first embodiment of the information processing system of the invention. The history information collected in the collected history holding section 17 of the information intervention system A as described above may be recorded as character strings as shown above, but can also be recorded as binary data as shown in Figure 8, for example. Figure 14 shows representation of history information collected in the collected history holding section 17 as binary data. A field for storing the system identifier of the collection source (distribution source) information intervention system is provided in addition to the fields of the distribution history shown in Figure 8.

For example, the information on the second top row in Figure 14 is a distribution history collected from the information intervention system whose system identifier is "800287" and indicates that the information whose information identifier is "679840-176" was distributed from the information intervention system whose system identifier is "800287" to the information intervention system whose system identifier is "028765" at the time "1995031322233489." In the example, the system identifier "800287" is id-B, the system identifier "028765" is id-C, the information identifier "679840-176" is id-X, and the time "1995031322233489" is T2. That is, the information indicates

id-B: sent id-X to id-C at T2

This means that it is a history collected from the information intervention system whose system identifier is id-B and denotes that the information whose information identifier is id-X was distributed from the information intervention system whose system identifier is id-B to the information intervention system whose system identifier is id-C at the time T2.

When the history collection section 16 of the information intervention system A executed the processing shown in Figure 10, it stored the distribution history fetched from the home distribution history holding section 15 in the home collected history holding section 17 as the history information on the top row in Figure 14.

Next, the processing of the tracing analysis section 18 in the information intervention system A starting the tracing will be discussed with reference to Figures 9 and 11. The tracing analysis section 18 operates subsequently to the processing of the history collection section 16. Here, processing after reports for the instruction issued by the history collection section 16 to the information intervention system B are returned will be discussed. The collected history holding section 17 of the information intervention system A stores the history information sent from the information intervention sys-

tems B, C, and D as described above.

First, at step S71, the tracing analysis section 18 in the information intervention system A assigns the information identifier of the information to be traced, id-X, to the variable X. Next, at step S72, it reads the history information related to the information identifier id-X from the collected history holding section 17, and assigns the history information to the variable History2. The following five history information entries are assigned to the variable History2:

id-A: sent id-X to id-B at T1  
 id-B: sent id-X to id-C at T2  
 id-B: sent id-X to id-D at T3  
 id-C: null  
 id-D: null

At step S73, whether or not the variable History2 is null is checked. Since it is not null, control goes to step S74 at which four nodes corresponding to the source system identifiers id-A, id-B, id-C, and id-D of all history information contained in the variable History2 are prepared.

At step S75, whether or not the variable History2 is null is checked. At this point in time, it is not null, and control goes to step S76 at which one history information entry is fetched from the variable History2 and is assigned to the variable H2. Here, assume that

id-A: sent id-X to id-B at T1

is fetched. It is assigned to the variable H2. At step S77, the source system identifier id-A, the destination system identifier id-B, and the time T1 in the variable H2 are assigned to the variables M-from, M-to, and Time respectively. At step S78, an arc from the node M-from to the node M-to, namely, an arc from the node id-A to the node id-B is prepared. Then, control returns to step S75.

At this point in time, the variable History2 is not yet null. Then, at step S76, one of the history information entries

id-B: sent id-X to id-C at T2

is fetched from the variable History2 and is assigned to the variable H2. At steps S77 and S78, an arc from the node id-B to the node id-C is prepared. Likewise, an arc from the node id-B to the node id-D is prepared from the history information entry

id-B: sent id-X to id-D at T3

For the remaining history information entries

id-C: null  
 id-D: null,

the nodes id-C and id-D are set to the terminating nodes at step S78.

Since the variable History2 is now null, the condition at step S75 becomes true and control goes to step S79. When control goes to step S79, the four nodes for id-A, id-B, id-C, and id-D, the three arcs "id-A -> id-B," "id-B -> id-C," and "id-B -> id-D," and the terminating nodes

at id-C and id-D are already prepared, thus the chart thereof is displayed on the tracing result display section 19.

Figure 15 is an illustration of an example of display of the tracing result display section in the first embodiment of the information processing system of the invention. The four nodes, the three arcs, and the two terminating nodes have been prepared as described above, based on which a graph, for example, as shown in Figure 15 can be displayed.

In the display example shown in Figure 15, a QUIT button for closing the window, an information name input area, and a RETRIEVE button are displayed on the top of the window of the tracing result display section 19. The user enters the name of the information whose tracing result is to know in the input field to the right of the INFORMATION NAME indication. The user can give an information analysis command to the history collection section 16 by pressing the RETRIEVE button. Here, assume that the user is to know the distribution route of information X having information identifier id-X and enters information X as the information name. After entering the information name, he or she presses the RETRIEVE button. Since the RETRIEVE button is a virtual button, the user can click a mouse button on the position of the RETRIEVE button, for example.

In the example shown in Figure 15, the nodes prepared as described above are indicated by circles and the arcs are indicated by arrows. The distribution time of day is displayed near each arrow. The node indicating the information intervention system starting the tracing differs from other nodes in display method. The node is hatched in Figure 15 for convenience of the illustration; in fact, it can be displayed by changing the color, brightness, etc. Such graphical distribution route display enables the user to know the information distribution route in a visual form.

Thus, the first embodiment enables the user to trace the transfer and distribution route and distribution range of information following one information intervention system.

In the description, in the information tracing processing, each information intervention system instructed to check history information and return a report sends a report directly to the information intervention system first starting the tracing processing, but the invention is not limited to the configuration. A report may be sent to the information intervention system giving the instruction for checking history information and returning a report and be passed in the reverse order to the information distribution order.

In the description, the history information contains the distribution time of day in addition to the information identifier and the system identifiers. However, to know only the distribution route, etc., the distribution time of day is not necessarily required and may be omitted. However, to obtain information on the information transfer time or to know which distribution was first executed,

for example, when the same information was distributed or received from more than one information intervention system, it is convenient to also contain the distribution time of day in the history information. Of course, other information pieces may be recorded as history information.

Second embodiment:

Next, a second embodiment of the information processing system of the invention will be discussed. The embodiment is configured so that information can be traced as to what transfer and distribution route the information was distributed on to one system.

Like the first embodiment, the basic configuration in the second embodiment is shown in Figure 1 and therefore the sections will not be discussed again in detail. The second embodiment differs from the first embodiment basically in the distribution history contents recorded in a distribution history holding section 15 when information is distributed and in the tracing request direction when information is traced. Specifically, when information is distributed, the system identifier of the information destination is recorded in the distribution history holding section 15 of the source information intervention system in the first embodiment; whereas the system identifier of the information source is recorded in a distribution history holding section 15 of the destination information intervention system in the second embodiment. When information is traced, it is traced in the same order as the information was distributed in the first embodiment; whereas it is traced in the reverse order to how the information was distributed in the second embodiment. Such a configuration enables the user to know what route the received information was distributed via, for example.

When information is distributed (received), a distribution sensing section 14 records the information identifier of the information in the distribution history holding section 15 together with the system identifier of the source information intervention system.

A history collection section 16 reads a distribution history from the distribution history holding section 15 and based on the distribution history, requests the source information intervention system to collect the distribution histories of the information preceding the source information intervention system in order and return the distribution histories to the information intervention system giving the collection instruction. Of course, it may request the information intervention system to return the distribution histories to the information intervention system starting the tracing.

Next, the operation in the second embodiment of the information processing system of the invention will be outlined. Figure 16 is an illustration of an example of an information flow in the second embodiment of the information processing system of the invention. It shows four information intervention systems A-D and gives an

example in which information X is distributed from information intervention system A to information intervention system B to information intervention system C to information intervention system D.

The information intervention system B senses distribution of the information X from the information intervention system A and records its distribution history in the distribution history holding section 15. Likewise, the information intervention system C (D) also senses distribution of the information X from the information intervention system B (C) and records its distribution history in the distribution history holding section 15.

When an instruction for tracing the distribution route of the information X is given in the information intervention system D, the distribution history of the information X is fetched from the distribution history holding section 15 of the information intervention system D and the information intervention system C from which the information X was distributed is instructed to trace the distribution route of the information X. Here, a method of passing the histories in the reverse order to how the information was distributed is adopted as the tracing result reporting method. Upon reception of the instruction for tracing the distribution route of the information X from the information intervention system D, the information intervention system C fetches the distribution history of the information X from its distribution history holding section 15 and instructs the information intervention system B from which the information X was distributed to trace the distribution route of the information X. Likewise, the information intervention system B also fetches the distribution history of the information X from its distribution history holding section 15 and instructs the information intervention system A from which the information X was distributed to trace the distribution route of the information X. The information intervention system A, which does not hold the distribution history of the information X, does not give an additional tracing instruction and returns a message to the effect that the distribution history related to the information X does not exist to the information intervention system B. The information intervention system B returns the distribution history when the information X was distributed from the information intervention system A and a message to the effect that the distribution history related to the information X does not exist in the information intervention system A to the information intervention system C. The information intervention system C returns the distribution history when the information X was distributed from the information intervention system B, the distribution history when the information X possessed by the information intervention system B was distributed from the information intervention system A, and a message to the effect that the distribution history related to the information X does not exist in the information intervention system A to the information intervention system D, whereby the information intervention system D can know that the information X was distributed as shown in Figure 16.

Thus, the information distribution route, distribution range, etc., can be analyzed.

A processing flow as described above will be discussed in detail. First, the information distribution operation will be discussed. Figure 17 is an illustration of an example of the information distribution operation in the second embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 1 are denoted by the same reference numerals in Figure 17. Here, a processing flow when information having information identifier id-X is distributed from information intervention system A to information intervention system B will be discussed.

As in Figure 7 in the first embodiment, the information intervention system A has the system identifier id-A. An information holding section 11 of the information intervention system A stores information having information identifier id-X (information X) and information having information identifier id-Y. The information intervention system B has system identifier id-B.

The processing flow when the information intervention system A distributes information to the information intervention system B is also the same as that in the first embodiment except for the distribution history entering location and contents. In the first embodiment, the information identifier id-X of the distributed information is recorded in the distribution history holding section 15 of the information intervention system A together with the destination system identifier id-B. In the second embodiment, the information identifier id-X of the distributed information is recorded in the distribution history holding section 15 of the information intervention system B together with the source system identifier id-A.

Specifically, first an information distribution section 12 of the information intervention system A searches the network for the information intervention system B based on the system identifier id-B thereof and establishes a connection to an information distribution section 12 of the information intervention system B. Next, the information distribution section 12 of the information intervention system A reads the information X from the information holding section 11 and distributes the information to the information distribution section 12 of the information intervention system B. Upon reception of the information X, the information distribution section 12 of the information intervention system B stores the information in the information holding section 11.

The distribution sensing section 14 of the information intervention system B senses the distribution process, namely, the reception process and records the information identifier id-X of the distributed information in the distribution history holding section 15 of the information intervention system B together with the source system identifier id-A. In the example shown in Figure 17, the distribution time T1 is added to the record as

received id-X from id-A at T1

This record denotes that the information having the in-

formation identifier id-X was received from the information intervention system having the information identifier id-A at the time T1.

Figure 18 is an illustration of an example after information distribution in the second embodiment of the information processing system of the invention. As described above, the information X was distributed from the information intervention system A to the information intervention system B. If the information flows, for example, as shown in Figure 16, it is furthermore distributed from the information intervention system B to the information intervention system C to the information intervention system D. Figure 18 shows the distribution history holding sections 15 of the information intervention systems A-D after the information is distributed as shown in Figure 16. Here, the system identifiers of the information intervention systems C and D are id-C and id-D respectively. Figure 18 shows only a part of the configuration in each information intervention system.

As in the information distribution process from the information intervention system A to the information intervention system B, the information is distributed from the information intervention system B to the information intervention system C. Resultantly, the distribution history

received id-X from id-B at T2

is recorded in the distribution history holding section 15 of the information intervention system C. Likewise, the information is distributed from the information intervention system C to the information intervention system D and resultantly, the distribution history

received id-X from id-C at T3

is recorded in the distribution history holding section 15 of the information intervention system D. Thus, each time information is distributed, its distribution history is recorded in the distribution history holding section 15 of the source information intervention system.

Next, information tracing processing will be discussed with Figure 18. In the description, a method of passing the histories in the reverse order to how the information was distributed is adopted as the tracing result reporting method. Of course, the method of returning all reports to the information intervention system starting the tracing may be adopted as in the first embodiment.

First, when an information X transfer and distribution route tracing instruction is given in the information intervention system D, the history collection section 16 of the information intervention system D reads the distribution histories related to the information identifier id-X of the information X from the distribution histories stored in the distribution history holding section 15. In the example, only one distribution history

received id-X from id-C at T3

is found. This distribution history indicates that the information X was distributed from the information intervention system C having the system identifier id-C at the time T3. Then, the history collection section 16 of the information intervention system D requests the history

collection section 16 of the information intervention system C to trace the transfer and distribution route of the information X and report the tracing result to the information intervention system D. In addition, it stores a pair of the distribution history and the system identifier id-D of the information intervention system D, namely, the following history information

id-D: received id-X from id-C at time T3

in a collected history holding section 17 of the information intervention system D.

The history collection section 16 of the information intervention system C, which receives the request from the information intervention system D, reads the distribution histories related to the information identifier id-X of the information X from the distribution histories stored in the distribution history holding section 15. In the example, the following distribution history

received id-X from id-B at T2

is found. The history collection section 16 of the information intervention system C stores a pair of the distribution history and the home system identifier id-C, namely, the following history information

id-C: received id-X from id-B at time T2

in a collected history holding section 17 of the information intervention system C. Further, the distribution history indicates that the information X was distributed from the information intervention system B having the system identifier id-B at the time T2. Then, the history collection section 16 of the information intervention system C requests the information intervention system B to trace the transfer and distribution route of the information X and report the tracing result to the information intervention system C.

Likewise, the history collection section 16 of the information intervention system B reads the distribution histories related to the information identifier id-X of the information X from the distribution history holding section 15 and stores the following history information

id-B: received id-X from id-A at time T1

in a collected history holding section 17 of the information intervention system B and requests the information intervention system A to trace the transfer and distribution route of the information X and report the tracing result to the information intervention system B.

Likewise, the history collection section 16 of the information intervention system A attempts to read the distribution histories related to the information identifier id-X of the information X from the distribution history holding section 15, but the distribution history holding section 15 of the information intervention system A does not store any distribution history related to the information identifier id-X of the information X. Thus, the history collection section 16 of the information intervention system A reports the following information

id-A: null

to the information intervention system B.

The history collection section 16 of the information intervention system B, which receives the report from

the history collection section 16 of the information intervention system A, fetches the history information

id-B: received id-X from id-A at time T1

from the collected history holding section 17, adds it to the history information received from the information intervention system A, and reports the information to the information intervention system C.

Likewise, the history collection section 16 of the information intervention system C, which receives the report from the history collection section 16 of the information intervention system B, fetches the history information from the collected history holding section 17, adds it to the history information received from the information intervention system B, and reports the information to the information intervention system D.

The history collection section 16 of the information intervention system D, which receives the report from the history collection section 16 of the information intervention system C, stores the received history information in the collected history holding section 17 of the information intervention system D. Finally, the following history information

id-A: null

id-B: received id-X from id-A at time T1

id-C: received id-X from id-B at time T2

id-D: received id-X from id-C at time T3

is stored in the collected history holding section 17 of the information intervention system D.

A tracing analysis section 18 of the information intervention system D analyzes the history information and determines that the information X was distributed from the information intervention system A to the information intervention system B to the information intervention system C to the information intervention system D. It displays the analysis result on a tracing result display section 19.

Figure 19 is an illustration of an example of display of the tracing result display section in the second embodiment of the information processing system of the invention. The display form in Figure 19 is similar to that in Figure 15. According to the history information collected in the collected history holding section 17 of the information intervention system D as described above, the existing information intervention systems A, B, C, and D are indicated by circles as nodes and the three arcs "id-A -> id-B," "id-B -> id-C," and "id-C -> id-D" are prepared and indicated by arrows. The distribution time of day is displayed near each arrow. In the display example shown in Figure 19, the node indicating the information intervention system D starting the tracing differs from other nodes in display way.

Third embodiment:

Next, a third embodiment of the information processing system of the invention will be discussed.

The embodiment enables tracing of all transfer and distribution routes and all distribution ranges of information. Basically, it is provided by combining the first and second embodiments, wherein information can be traced in the same order as and the reverse order to how it was distributed from one information intervention system, and all transfer and distribution routes and all distribution ranges of information can be traced. The second embodiment is the same as the first embodiment in basic configuration, shown in Figure 1 and therefore the sections will not be discussed again in detail.

When receiving information distribution from any other information intervention system, a distribution sensing section 14 records the information identifier of the information in a distribution history holding section 15 together with the system identifier of the source information intervention system. When distributing information to any other information intervention system, it records the information identifier of the information in the distribution history holding section 15 together with the system identifier of the destination information intervention system.

A history collection section 16 reads distribution histories from the distribution history holding section 15 and based on the read distribution histories, requests the destination and source information intervention systems to collect the distribution histories of the information preceding and following the information intervention systems in order and return the distribution histories to the information intervention system starting the tracing. Of course, it may request the information intervention systems to return the distribution histories to the information intervention system receiving the tracing instruction.

Next, the operation in the third embodiment of the information processing system of the invention will be outlined. Figure 20 is an illustration of an example of an information flow in the third embodiment of the information processing system of the invention. It shows six information intervention systems A-F and gives an example in which information X is distributed from information intervention system A to information intervention systems B and F, from information intervention system B to information intervention systems C and D, from information intervention system C to information intervention system D, and from information intervention system D to information intervention system E.

The information intervention system A records distribution histories of distribution of the information X to the information intervention systems B and F in the distribution history holding section 15. The information intervention system B records distribution histories of distribution of the information X from the information intervention system A and distribution of the information X to the information intervention systems C and D in the distribution history holding section 15. Likewise, the information intervention system C records distribution histories of distribution of the information X from the information intervention system B and distribution of the in-



formation X to the information intervention system D in the distribution history holding section 15; the information intervention system D records distribution histories of distribution of the information X from the information intervention systems B and C and distribution of the information X to the information intervention system E in the distribution history holding section 15; the information intervention system E records a distribution history of distribution of the information X from the information intervention system D in the distribution history holding section 15; and the information intervention system F records a distribution history of distribution of the information X from the information intervention system A in the distribution history holding section 15.

When an instruction for tracing the distribution route of the information X is given in the information intervention system B, the distribution histories of the information X are fetched from the distribution history holding section 15 of the information intervention system B. In this case, since the distribution histories of distribution of the information X from the information intervention system A and distribution of the information X to the information intervention systems C and D are recorded, the information intervention system B instructs the information intervention systems to trace the distribution routes of the information X. It can know all distribution routes and distribution ranges of the information as shown in Figure 20 by carrying out an analysis on the history information collected from the information intervention systems. Thus, the third embodiment enables the user to trace all distribution routes of information from any information intervention system to which analysis information was distributed.

A processing flow as described above will be discussed in detail. First, the information distribution operation will be discussed. Information distribution processing is a combination of the processing shown in the first embodiment and that in the second embodiment. Distribution of the information X from the information intervention system A to the information intervention system B is considered. In this case, as shown in Figure 7, the distribution history

sent id-X to id-B at T1

is recorded in the distribution history holding section 15 of the source information intervention system A. As shown in Figure 17, the distribution history

received id-X from id-A

is recorded in the distribution history holding section 15 of the destination information intervention system B. At this time, the distribution time of day may be recorded in either of them; in the example, it is recorded only in the distribution history recorded in the source information intervention system. It can also be recorded only in the distribution history recorded in the destination information intervention system or in the distribution histories recorded in both the source and destination information intervention systems.

Figure 21 is an illustration of an example after infor-

mation distribution in the third embodiment of the information processing system of the invention. As described above, the information X was distributed from the information intervention system A to the information intervention system B. If the information flows, for example, as shown in Figure 20, further the distribution history

sent id-X to id-F at T6

indicating that the information X was distributed to the information intervention system F is recorded in the distribution history holding section 15 of the information intervention system A. When the information X was distributed to the information intervention system F, the distribution history

received id-X from id-A

is recorded in the distribution history holding section 15 of the information intervention system F.

Further, the distribution histories

sent id-X to id-C at T2

sent id-X to id-D at T3

indicating that the information X was distributed to the information intervention systems C and D are recorded in the distribution history holding section 15 of the information intervention system B. When the information X was distributed to the information intervention systems C and D, the distribution history

received id-X from id-B

is recorded in the distribution history holding sections 15 of the information intervention systems C and D. Since the information intervention system C further distributes the information X to the information intervention system D, further the distribution history

sent id-X to id-D at T4

is recorded in the distribution history holding section 15 of the information intervention system C. In response to this, the distribution history

received id-X from id-C

is recorded in the distribution history holding section 15 of the information intervention system D. Since the information intervention system D distributes the information X to the information intervention system E, further the distribution history

sent id-X to id-E at T5

is recorded in the distribution history holding section 15 of the information intervention system D. In response to this, the distribution history

received id-X from id-D

is recorded in the distribution history holding section 15 of the information intervention system E. When distribution of the information X as shown in Figure 20 was thus executed, the distribution histories as shown in Figure 21 are recorded in the distribution history holding sections 15 of the information intervention systems A-F.

Next, transfer and distribution route tracing processing of the information X from the information intervention system B will be discussed with the example shown in Figure 21. In the description that follows, assume that an information X transfer and distribution

route tracing instruction is given in the information intervention system B.

When an information X transfer and distribution route tracing instruction is given in the information intervention system B, the history collection section 16 of the information intervention system B reads the distribution histories related to the information identifier id-X of the information X from the distribution histories stored in the distribution history holding section 15. In the example, the following three distribution histories

received id-X from id-A  
sent id-X to id-C at T2  
sent id-X to id-D at T3

are found.

These found distribution histories indicate that the information intervention system B received the information X from the information intervention system A and distributed it to the information intervention systems C and D at the times T2 and T3. The information intervention system B requests the information intervention systems A, C, and D to trace the transfer and distribution routes of the information X preceding and following the systems A, C, and D and report the tracing result to the information intervention system B. In addition, it stores pairs of each of the distribution histories and the system identifier id-B of the information intervention system B in the collected history holding section 17.

Each of the information intervention systems A, C, and D, which receives the request from the information intervention system B, reads the distribution histories related to the information identifier id-X of the information X from the distribution histories stored in the distribution history holding section 15. Based on the distribution histories, the information intervention systems A, C, and D request their preceding and following information intervention systems to trace the transfer and distribution routes of the information X and report the tracing result to the information intervention system B. In addition, each of the systems A, C, and D returns pairs of each of the read distribution histories and its own system identifier to the information intervention system B.

For example, the information intervention system A fetches the distribution histories recorded in the distribution history holding section 15

sent id-X to id-B at T1  
sent id-X to id-F at T6

and requests the information intervention systems B and F to trace the transfer and distribution routes of the information X and report the tracing result to the information intervention system B. In addition, it returns the history information consisting of the distribution histories and its system identifier in pairs

id-A: sent id-X to id-B at T1

id-A: sent id-X to id-F at T6

to the information intervention system B.

Likewise, the information intervention system F, which receives the request from the information intervention system A, returns the history information

id-F: received id-X from id-A

to the information intervention system B. At this time, the information intervention system F requests the information intervention system to trace the transfer and distribution route of the information X and report the tracing result to the information intervention system B. However, As described in the flowchart of the information tracing processing in the first embodiment of the invention shown in Figure 10, the tracing instruction id is used to check a process loop, thus the information intervention system A does not perform duplicate information tracing processing, whereby an infinite loop of a request between the information intervention systems can be prevented.

Likewise, each of the information intervention systems C, D, and E returns pairs of each of the distribution histories recorded in the distribution history holding section 15 and the system identifier to the information intervention system B. The information intervention system B stores the history information sent from the information intervention systems in the collected history holding section 17. Finally, the following history information

id-B: received id-X from id-A  
id-B: sent id-X to id-C at T2  
id-B: sent id-X to id-D at T3  
id-C: received id-X from id-B  
id-C: sent id-X to id-D at time T4  
id-D: received id-X from id-B  
id-D: received id-X from id-C  
id-D: sent id-X to id-E at time T5  
id-E: received id-X from id-D  
id-A: sent id-X to id-B at time T1  
id-A: sent id-X to id-F at time T6  
id-F: received id-X from id-A

is stored in the collected history holding section 17 of the information intervention system B.

A tracing analysis section 18 of the information intervention system B analyzes the history information, thereby determining all distribution routes of the information X and displaying the analysis result on a tracing result display section 19. An example analysis method is as follows:

As the distribution histories are recorded as described above, a history is recorded in both destination and source systems in one distribution. That is, the history information stored in the collected history holding section 17 contains duplicate information indicating the same fact. Thus, it is sufficient to use only either of them for analyzing the distribution route. For example, only the history information related to "sent" can be selected

from the above-mentioned history information for use.  
The selected history information is as follows:

id-B: sent id-X to id-C at T2  
id-B: sent id-X to id-D at T3  
id-C: sent id-X to id-D at time T4  
id-D: sent id-X to id-E at time T5  
id-A: sent id-X to id-B at time T1  
id-A: sent id-X to id-F at time T6

Of course, only the history information related to "received" can be selected for use.

Next, the system identifiers are extracted from the selected history information and nodes are prepared for them. Here, the six nodes id-A, id-B, id-C, id-D, id-E, and id-F can be prepared. Further, the following arcs are prepared from the history information:

id-B  $\Rightarrow$  id-C at T2  
id-B  $\Rightarrow$  id-D at T3  
id-C  $\Rightarrow$  id-D at T4  
id-D  $\Rightarrow$  id-E at T5  
id-A  $\Rightarrow$  id-B at T1  
id-A  $\Rightarrow$  id-F at T6

The analysis is now complete and the result is displayed on the tracing result display section 19.

Figure 22 is an illustration of an example of display of the tracing result display section in the third embodiment of the information processing system of the invention. The display form in Figure 21 is similar to that in Figure 15. According to the result of the analysis using the history information collected in the collected history holding section 17 of the information intervention system B as described above, for example, the distribution route of the information X can be displayed as shown in Figure 22. Nodes are indicated by circles and arcs are indicated by arrows. The distribution time of day is displayed near each arrow. The node indicating the information intervention system B differs from other nodes in display way so that the information intervention system starting the tracing can be seen.

By seeing such display, the user can grasp the entire distribution routes and distribution ranges of the information X. The distribution time display enables the user to know the distribution timing as to whether distribution of the information X from the information intervention system D to the information intervention system E, for example, was executed after distribution from the information intervention system B or C or both systems.

Fourth embodiment:

Next, a fourth embodiment of the information processing system of the invention will be discussed. In the embodiment, histories related to information prepared or changed by the user are also recorded, whereby if information is modified in an intermediate point of

distribution of the information, it can be traced throughout the information distribution route containing the modification.

The embodiments we have discussed assume that information is distributed via a large number of information intervention systems with the original information intact without modification, and the distribution route of the information is traced. However, in the fourth embodiment, if information is modified in an intermediate point of distribution of the information or new information is prepared based on several information items, not only the modified information, but also integration of the original information and the modified information can be traced.

Figure 23 is block diagrams to show a fourth embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 1 are denoted by the same reference numerals in Figure 23 and will not be discussed again. In Figure 23, numeral 21 designates an information processing section; numeral 22, an information identifier management section; and numeral 23, an information preparation sensing section. The fourth embodiment is similar to the first to third embodiments in basic configuration; the information identifier management section 22 for giving a new information identifier to information when the information is prepared or modified and the information preparation sensing section 23 for sensing information preparation or modification and storing its history information in a distribution history holding section may be added to the configuration shown in Figure 1. The information processing section 21 is a section for generally processing information and here for preparing, modifying, etc., information.

When information is prepared or modified, the information identifier management section 22 gives a new information identifier to the information. Information identifiers are managed so that they are not duplicate with those given by other information intervention systems. As an possible information identifier management method, for example, a combination of the system identifier held in each information intervention system and a serial number given to information prepared or changed through the information intervention system is used as the information identifier of the information. For example, if the system identifier is 6892678, it is combined with the serial numbers to information prepared or changed on the information intervention system to produce 6892678-1, 6892678-2, 6892678-3, ... used as the information identifiers, whereby duplication of the identifiers for information can be avoided.

The information preparation sensing section 23 monitors the information processing section 12 for sensing information preparation or modification, and stores its preparation history in a distribution history holding section 15. For example, if information whose information identifier is W is prepared at time T1, the following

preparation history

created W at T1

is stored in the distribution history holding section 15. If information whose information identifier is P is prepared based on information whose information identifier is Q at time T2, the preparation history

created P from Q at T2

is stored in the distribution history holding section 15.

Next, the operation in the fourth embodiment of the information processing system of the invention will be outlined. Figure 24 is an illustration of an example of an information flow in the fourth embodiment of the information processing system of the invention, wherein the dotted lines denote a flow of information X, the alternate long and short dash line denotes a flow of information Y, and the solid line denotes a flow of information Z.

Like Figure 4, Figure 24 shows four information intervention systems A-D, wherein information X is prepared in the information intervention system A and is distributed from the information intervention system A to the information intervention system B from which it is distributed to the information intervention systems C and D. In the embodiment, after such distribution, the information X is modified to prepare information Y in the information intervention system D and the information Y is distributed to the information intervention system B. Further, the information Y is modified to prepare information Z in the information intervention system B and the information Z is distributed to the information intervention system C.

Figure 25 is an illustration of an example after information distribution in the fourth embodiment of the information processing system of the invention. When information distribution as shown in Figure 24 is executed, distribution and preparation histories are recorded in the distribution history holding sections 15 of the information intervention systems A-D. At this time, the distribution histories are stored as in the first embodiment. Of course, they can also be recorded as in the second or third embodiment.

First, the information X is prepared in the information intervention system A. When the information X is prepared in the information processing section 21, the information identifier management section 22 gives information identifier id-X to the prepared information X. The information preparation sensing section 23 senses preparation of the information X in the information processing section 21, prepares the preparation history

created id-X at T1

from the information identifier id-X of the information X and the preparation time T1, and records it in the distribution history holding section 15. As in the first embodiment, the distribution history of the information X

sent id-X to id-B at T2

is recorded in the distribution history holding section 15 of the information intervention system A and the distribution histories of the information X

sent id-X to id-C at T3

sent id-X to id-D at T4

are recorded in the distribution history holding section 15 of the information intervention system B.

Since the information Y is prepared based on the information X in the information intervention system D, the preparation history

created id-Y from id-X at T5

is recorded in the distribution history holding section 15 of the information intervention system D and as the information Y is distributed to the information intervention system B, the distribution history of the information Y

sent id-Y to id-B at T6

is also recorded therein.

Since the information Z is prepared based on the information Y received from the information intervention system C in the information intervention system B and is distributed to the information intervention system D, further the following preparation and distribution histories

created id-Z from id-Y at T7

sent id-Z to id-D at T8

are recorded in the distribution history holding section 15 of the information intervention system B.

Finally, as shown in Figure 25, the preparation and distribution histories are recorded in the distribution history holding sections 15 of the information intervention systems A-D.

Next, transfer and distribution route tracing processing of the information X and its modified information from the information intervention system A will be discussed with the example shown in Figure 25. When a transfer and distribution route tracing instruction of the information X and its modified information is given in the information intervention system A, the information intervention systems perform similar processing to that shown in the first embodiment.

Only the information X is traced in the first embodiment; in the fourth embodiment, if a preparation history based on the information X exists, subsequently prepared information is also traced.

Specifically, when the information intervention system B instructs the information intervention system D to trace the information X, the information intervention system D fetches the preparation history

created id-Y from id-X at T5

from the distribution history holding section 15 and fetches the distribution history related to the information identifier id-Y, then starts tracing the information Y as in the first embodiment. It instructs the information intervention system B to trace the information Y. The information intervention system B does not contain the distribution history of the information Y, but contains the preparation history based on the information Y

created id-Z from id-Y at T7

A history collection section 16 of the information intervention system B fetches the preparation history from the distribution history holding section 15 and based on the preparation history, further fetches the distribution history related to the information identifier id-Z from the distribution history holding section 15 and performs tracing processing for the information Z.

After all, a collected history holding section 17 of the information intervention system A stores the following history information:

```
id-A: created id-X at T1
id-A: sent id-X to id-B at T2
id-B: sent id-X to id-C at T3
id-B: sent id-X to id-D at T4
id-B: created id-Z from id-Y at T7
id-B: sent id-Z to id-C at T8
id-C: null
id-D: created id-Y from id-X at T5
id-D: sent id-Y to id-B at T6
```

Figure 26 is an illustration of an example of the contents of the collected history holding section in the fourth embodiment of the information processing system of the invention. The history information collected in the collected history holding section 17 of the information intervention system A as described above may be recorded as character strings as shown above, but can also be recorded as binary data as shown in Figure 8, for example. Figure 26 shows representation of history information collected in the collected history holding section 17 as binary data. Each history information entry consists of a collection source system identifier, operation type, target information identifier, original information identifier, destination system identifier, and time.

The operation type in the embodiment is provided for distinguishing "send" from "create" and may be a 1-bit flag. When the operation type is "send," information is stored in the target information identifier, the destination system identifier, and the time. When the operation type is "create," information is stored in the target information identifier, the original information identifier, and the time. If new information is prepared, the original information identifier is made null.

After the history collection, a tracing analysis section 18 of the information intervention system A analyzes the collected history information as in the first embodiment. First, four nodes id-A, id-B, id-C, and id-D are prepared based on the system identifiers of the information intervention systems A-D. Next, arcs are prepared based on the history information having "sent" for each information identifier. The following five arcs are prepared:

```
id-X: id-A -> id-B at T2
id-X: id-B -> id-C at T3
id-X: id-B -> id-D at T4
id-Z: id-B -> id-C at T8
```

id-Y: id-D -> id-B at T6

Further, information modification histories are prepared based on the history information having "created."  
The following modification histories are prepared:

```
id-A: null -> id-X at T1
id-B: id-Y -> id-Z at T7
id-D: id-X -> id-Y at T5
```

The analysis is now complete, then the result is displayed on a tracing result display section 19.

Figure 27 is an illustration of an example of distribution route display of a tracing result display section in the fourth embodiment of the information processing system of the invention. Figure 28 is an illustration of an example of preparation process display of the tracing result display section in the fourth embodiment of the information processing system of the invention. In information distribution route display, the tracing result of only a single information item is displayed in the first embodiment; the tracing result display section 19 in the fourth embodiment displays trace information and modification histories of more than one information item.

Therefore, information items need to be distinguished from each other. As shown in Figure 27, the information names, such as "X (T2)" and "Y (T6)," are displayed near the arrow lines connecting the information intervention systems, and further the information items are displayed in different line types. This is an example, and various display methods can be used, for example, different colors are used to distinguish the information items. Of course, the tracing result may be displayed separately for each information item as in the first embodiment depending on selection of the user.

As shown in Figure 28, only information preparation and modification histories may be extracted for display. In the display example shown in Figure 28, the information items are represented as nodes, which are circled. Information modification based on a preparation history is represented as an arc, which is denoted by an arrow. The display example shown in Figure 28 means that the information X was prepared in the information intervention system A at the time T1, that the information Y was prepared based on the information X in the information intervention system B at the time T5, and that the information Z was prepared based on the information Y in the information intervention system D at the time T7.

The display forms can be switched whenever necessary as commanded by the user. Any other display form such as a table format may be adopted, needless to say.

In the fourth embodiment, information preparation or modification histories are also recorded in addition to information distribution histories. Further, a detailed information history may be recorded as to how which part of information is modified. In addition, a history related to use of information may be recorded. For example,

such a history indicating that information was used by one application may be recorded. In doing so, use of the information by one application can be traced.

#### Fifth embodiment:

Next, a fifth embodiment of the information processing system of the invention will be discussed. In the embodiments we have discussed, information is provided with an information label section in which its information identifier is held. In the fifth embodiment, information does not have an information label section and consists of only an information main body, and an information identifier is calculated from the information main body as required.

Figure 29 is a block diagram to show the fifth embodiment of the information processing system of the invention. Figure 30 is an illustration of an example of the format of information in the fifth embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 1 are denoted by the same reference numerals in Figure 29 and will not be discussed again. In Figure 29, numeral 24 designates an information identifier calculation section. An information intervention system 1 in the fifth embodiment has the information identifier calculation section 24 in addition to the configuration of the first embodiment, as shown in Figure 29. The information identifier calculation section 24 calculates an information identifier to distinguish one information item from other information items from the information main body. On the other hand, information consists of only an information main body, as shown in Figure 30.

In the first embodiment, when information is distributed from one system to another, the distribution sensing section 14 records the information identifier of the information in the distribution history holding section 15 of the source information intervention system together with the destination system identifier of the information. At the time, the information identifier held in the information label section of the information is used as the information identifier recorded in the distribution history holding section 15. In contrast, in the fifth embodiment, an information identifier calculated by the information identifier calculation section 24 from the information main body is used as the information identifier recorded in a distribution history holding section 15 when information is distributed.

That is, in the first embodiment, one information X has an information label section in which, for example, information identifier id-X is previously held. When the information X is distributed from the information intervention system A to the information intervention system B, the distribution sensing section 14 of the information intervention system A senses the distribution process and records the information identifier id-X of the distributed information X in the distribution history holding sec-

tion 15 of the information intervention system A together with the destination system identifier id-B.

In contrast, in the fifth embodiment, information X consists of only the information main body thereof and does not hold an information identifier such as id-X. For example, when the information X is distributed from information intervention system A to information intervention system B, a distribution sensing section 14 of the information intervention system A senses the distribution process and records the information identifier of the distributed information X in the distribution history holding section 15 of the information intervention system A together with the destination system identifier id-B. At this time, the information X does not hold its information identifier, but the information identifier calculation section 24 of the information intervention system A calculates an information identifier of the information X based on the information main body thereof and records the information identifier in the distribution history holding section 15. Assuming that the information identifier of the information X calculated by the information identifier calculation section 24 is id-X', a distribution history is recorded as

sent id-X' to id-B at T1

in the distribution history holding section 15 of the information intervention system A as in the first embodiment.

The information identifier calculation section 24 is adapted to calculate and output the same information identifier for the same information regardless of which information intervention system the information identifier calculation section 24 exists in, enabling the information X to be handled as if it held the information identifier id-X'.

Such a configuration enables the invention to also be applied to information having no information label section. Since information does not have an information label section, an event in which the information cannot be processed because the information main body and information label section are separated does not occur.

The information identifier calculation method in the information identifier calculation section 24 may be any if it can calculate, based on an information main body, an information identifier capable of distinguishing one information item from others in an environment to which the invention is applied. For example, a unidirectional hash function often used in cryptographic theories can be used.

The unidirectional hash function is a function for converting a bit string of any length into a bit string of a certain length, and has a feature of scarcely outputting the same value if different bit strings are input. It is often used with cryptographic theories, and has a feature of outputting different values if data is compressed to a certain length and input data is different. This feature can be used to identify information in the embodiment. For example, in OKAMOTO Eiji, "Angou Riron Nyumon (Introduction to Cryptographic Theories)" Kyouritsu Shuppan Kabushikigaisha, 1993, pp.138-140, a large

number of specific unidirectional hash function examples are proposed. One of them is SHA (secure hash algorithm). According to the book, the SHA, which is a standard proposal of the unidirectional hash function indicated by Standard Bureau of Department of Commerce in the United States (NIS), outputs 160 bits as a hash value for a message (information to be transmitted) of any length (less than 264 bits). As a hash function example by the SHA, the book describes SHA output of a message consisting of ASCII code of a, b, c

01100001 01100001 01100011

becomes

0164B8A9 14CD2A5E 74C4F7FF 082C4D97  
F1EDF880

in 32-bit word units.

The SHA, which is described in detail in the book, comprises the following three steps:

- (1) Dividing a message by a certain length;
- (2) performing operations of exclusive OR, bit shift, etc., in combination for each message division; and
- (3) outputting a hash value based on the operation results at step (2) for all message divisions.

By performing such processing, the information identifier calculation section 24 calculates an information identifier from the information main body. The distribution sensing section 14 uses the information identifier calculated by the information identifier calculation section 24 to prepare a history and records the prepared history in the distribution history holding section 15. Processing of other components is basically similar to that in the first embodiment and will not be discussed again. The fifth embodiment can also be applied to the second to fourth embodiments.

Sixth embodiment:

Next, a sixth embodiment of the information processing system of the invention will be discussed. The sixth embodiment enables tracing the information transfer and distribution route and distribution range in user units rather than system units.

Figure 31 is a block diagram to show the sixth embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 1 are denoted by the same reference numerals in Figure 31 and will not be discussed again. In Figure 31, numeral 25 designates a user certification section. The basic configuration of an information intervention system 1 is the same as that in the first embodiment except that it includes the user certification section 25 in place of the system label section 13 in the first embodiment.

The user certification section 25 holds the user identifier corresponding to the user. It certifies the user to be valid in an interactive mode if he or she is valid. When certification results in success, the user certifica-

tion section 25 enables use of the user identifier corresponding to the user. The user certification method may use a conventional technique with passwords, ID cards, etc., for example.

The user identifiers need to be managed so that they are not duplicate with other users in a tracing assumed area. The real format of the user identifier may be similar to the format of the information or system identifier as described so far.

After a user certification process is executed in the user certification section, the subsequent information distribution process and tracing process are almost the same as those in other embodiments except that the user identifiers rather than the system identifiers are used.

Figure 32 is an illustration of an example of information flows in the sixth embodiment of the information processing system of the invention. It resembles the example of information flows in the first embodiment shown in Figure 4. In the sixth embodiment, information X is distributed from user U1 to user U2 and from user U2 to users U3 and U4.

The processing flow when the user U1 distributes the information X to the user U2 will be simply discussed in relation to the first embodiment. A distribution sensing section 14 monitors an information distribution section 12 and can sense that the user U1 distributes the information X to the user U2. The distribution sensing section 14 of the user U1 senses the distribution process and records the information identifier id-X of the distributed information X in a distributed history holding section 15 of the user U1 together with the destination user identifier id-U2, for example, as a distribution history like  
sent id-X to id-U2 at T1

This distribution history means that the user U1 with the user identifier id-U1 distributed the information X with the information identifier id-X to the user U2 with the user identifier id-U2 at the time T1.

Next, an information tracing process flow will be simply discussed. When a transfer and distribution route tracing instruction of the information X is given from the user U1, a history collection section 16 of the user U1 reads distribution histories related to the information identifier id-X of the information X from the distribution histories stored in the distribution history holding section 15. In the example, the history information  
sent id-X to id-U2 at T1

is found. Then, the user U2 with the user identifier id-U2 is requested to trace the transfer and distribution route of the information X and report the tracing result to the user U1. In addition, the distribution history and the user identifier id-U1 of the user U1 are stored in a collected history holding section 17 in a pair. Such a process is repeated, whereby the history information based on the users is collected in the collected history holding section 17. The collected history information is analyzed, whereby information tracing based on the users can be executed.

Figure 33 is an illustration of an example of display

of a tracing result display section in the sixth embodiment of the information processing system of the invention. In the sixth embodiment, the user identifiers are extracted from the history information collected in the collected history holding section 17, and are used as nodes. Arcs are prepared from the history information. Thus, the nodes represent the users as compared with the display example in the first embodiment shown in Figure 15.

In the sixth embodiment, the information intervention systems are provided in a one-to-one correspondence with the users. However, a number of users often share a workstation, etc. In this case, a virtual information intervention system for each user may be constructed in the workstation. Such a virtual information intervention system can also be applied, for example, when the user uses a number of workstations on a network.

The configuration for using the user identifiers shown in the sixth embodiment can be applied not only to the first embodiment, but also to the second to fifth embodiments.

#### Seventh embodiment:

Next, a seventh embodiment of the information processing system of the invention will be discussed. In the embodiments discussed so far, information exchange connected by networks have mainly been described. However, information distribution is not limited to it. Information exchange disconnected from a network, for example, information distribution via information media disconnected from a network such as floppy disk may often be executed.

In this case, a problem is a broken link between the source and destination when information is distributed via information media. The source party can write information onto media without determining any destination and pass to nonspecific destinations. The information receiving party (destination) cannot locate the source of the information simply by seeing the information.

To solve the problem, either of the following two methods can be adopted:

- (1) Information is provided with a distribution history holding section for writing a distribution history consisting of a source system identifier and time of day; or
- (2) A medium is provided with a distribution history holding section for writing a distribution history consisting of a source system identifier and time of day.

These two methods differ only in distribution history holding location.

First, the method of providing information with a distribution history holding section for writing a distribution history consisting of a source system identifier and time of day will be discussed. Figure 34 is an illustration to show an example of the format of information when in-

formation is provided with a distribution history in the seventh embodiment of the information processing system of the invention. To hold a distribution history in information, a history information holding section is provided in an information label section of information stored on an information medium, as in the example shown in Figure 34. When information is recorded on an information medium, a distribution history consisting of the source system identifier and the time of day is written into the history information holding section in the information label section of the recorded information. At the destination, where the information was distributed from can be known by seeing the distribution history recorded in the history information holding section in the information label section of the information.

Figure 35 is an illustration of an example of the information distribution operation when information is provided with a distribution history in the seventh embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 17 are denoted by the same reference numerals in Figure 35 and will not be discussed again. In Figure 35, numeral 26 designates an information medium. Information in the format as shown in Figure 34 is recorded on the information medium 26.

When information is recorded on the information medium 26, a distribution sensing section 14 of the source system senses that the information is distributed to the information medium 26 and the source information intervention system writes a distribution history in the form

"written by id-A at T1"

into the history information holding section of the information, where id-A is the system identifier of the source information intervention system and T1 is the time of day.

When the information is distributed from the information medium 26 to a destination information intervention system, a distribution sensing section 14 of the destination system senses that the information is distributed from the information medium 26, and sees the distribution history recorded in the history information holding section of the distributed information for knowing where the information is distributed from. Based on the known fact, for example, the distribution history

"received id-X from id-A at T2"

is written into a distribution history holding section 15 of the destination information intervention system. The subsequent operation is similar to that in the second embodiment, for example.

After the information is received at the destination and the history is recorded in the distribution history holding section 15 of the destination system, the distribution history held in the history information holding section of the information may be erased. However, if there is a possibility that it will be distributed to another information intervention system, the distribution history may



be left intact until the information is erased.

Next, the method of providing an information medium with a history information holding section for writing a distribution history consisting of a source system identifier and time of day will be discussed. Figure 36 is an illustration to show an example of the format of information when an information medium is provided with a distribution history in the seventh embodiment of the information processing system of the invention. To hold a distribution history in an information medium 26, a medium label section is provided in the information medium 26 and a history information holding section is provided in the medium label section, for example, as shown in Figure 36. When information is recorded on the information medium 26, a distribution history consisting of the information identifier, the source system identifier, and the time of day is written into the history information holding section in the medium label section of the information medium 26. At the destination, the distribution history recorded in the history information holding section in the medium label section of the information medium 26 is seen, whereby where which information was distributed from can be known.

Figure 37 is an illustration of an example of the information distribution operation when an information medium is provided with a distribution history in the seventh embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 35 are denoted by the same reference numerals in Figure 37. When information is recorded on an information medium 26, the distribution sensing section 14 of the source system senses that the information is recorded on the information medium 26 and the source information intervention system writes, for example, the distribution history

"id-X was written by id-A at T1"

into the history information holding section of the information medium 26, where id-X is the information identifier of the information, id-A is the system identifier of the source information intervention system, and T1 is the time of day.

When the information is distributed from the information medium 26 to a destination information intervention system, the distribution sensing section 14 of the destination system senses that the information is distributed from the information medium 26, and sees the distribution history recorded in the history information holding section of the information medium 26 for knowing where the information is distributed from. For example, the distribution history

"received id-X from id-A at T2"

is written into the distribution history holding section 15 of the destination information intervention system. The subsequent operation is similar to that in the second embodiment, for example.

In this method, information such as the information source system identifier is written into the distribution

history holding section 15 of the destination information intervention system. Then, to further record the information destination system identifier in the distribution history holding section of the source information intervention system, when information is received at the destination information intervention system, the destination information intervention system can also inform the source information intervention system of reception of the information. An example for this purpose is given below:

Figure 38 is an illustration of an example of the information distribution operation in an eighth embodiment of the information processing system of the invention. Sections identical with or similar to those previously described with reference to Figure 37 are denoted by the same reference numerals in Figure 38 and will not be discussed again. In Figure 38, numeral 27 designates a distribution information notification section. The eighth embodiment assumes that information is distributed as with the case where an information medium is provided with a distribution history in the seventh embodiment.

The distribution information notification section 27 transfers information to and from distribution information notification sections 27 of other information intervention systems. It can see a distribution history recorded in a history information holding section of an information medium 26 for knowing where the information is distributed from. Then, the distribution information notification section 27 notifies the source information intervention system of reception of the information. The distribution information notification section 27 of the source information intervention system receives the information reception notification from the distribution information notification section 27 of the destination information intervention system and stores a distribution history in a distribution history holding section 15.

Now, assume that information is distributed from an information medium 26 to a destination. As in the seventh embodiment, when the information is distributed from the information medium 26 to the destination information intervention system, a distribution sensing section 14 of the destination system senses that the information is distributed from the information medium 26, and writes, for example, the distribution history

"received id-X from id-A at T2"

into a distribution history holding section 15 of the destination information intervention system. In the eighth embodiment, when sensing that the information is distributed from the information medium 26, the distribution sensing section 14 of the destination system records the distribution history in the distribution history holding section 15 and notifies the distribution information notification section 27, which then sees the distribution history recorded in the history information holding section of the information medium 26 for knowing where the information is distributed from, and notifies the source information intervention system of reception of the information.

Since the source information intervention system can know the information destination from the notification from the destination system, the distribution information notification section 27 receiving the notification writes, for example, the distribution history

"sent id-X to id-B at T1"

into the distribution history holding section 15 of the source information intervention system. In this case, as in the third embodiment, the distribution information is stored in both the source and destination systems. Thus, the subsequent operation is similar to that in the third embodiment.

In the eighth embodiment, without writing a distribution history into the distribution history holding section 15 of the destination information intervention system, the distribution information notification section 27 notifies the source information intervention system of reception of information and the distribution history can also be held in the distribution history holding section 15 of the source information intervention system. In this case, the distribution history is stored in the source system, as in the first embodiment. By using the eighth embodiment, even if information is distributed to a number of information intervention systems via an information medium 26, its distribution histories are stored in the source system. In this case, the subsequent operation is similar to that in the first embodiment.

In the seventh and eighth embodiments, preparation histories can also be held, information identifiers can also be calculated from information main bodies, or user identifiers can also be used as in the fourth to sixth embodiments.

The embodiments assume that if information is distributed between the information intervention systems, the information identifier does not change when the information is not modified. However, the invention is not limited to it. The invention can also be embodied so that whenever information is distributed between the information intervention systems, the information identifier is changed for preventing the information having identical information identifiers from existing. In this case, an information identifier change history may be stored in the distribution history holding section 15 together with a distribution history.

In the embodiments, the three information pieces of the time of day, destination or source system identifier, and information identifier are used as a distribution history, but the invention is not limited to them. For example, if time information is not required, the time of day need not be recorded. Both system and user identifiers may be recorded so as to trace a detailed distribution route as to information was distributed from what user in what information intervention system to what user in what information intervention system.

Further, in the embodiments, a distribution history is stored in the distribution history holding section of an information intervention system, but the invention is not limited to it. For example, information may be provided

with a portion for holding a distribution history apart from the information main body so that time information, a modification history, and the like are stored in the distribution history holding section of the information.

In the embodiments, the analysis result is only displayed. However, how the analysis result is used is not limited. The analysis result can be used in various manners; for example, such a component using the analysis result for automatically sending additional information to the persons receiving one information may be added.

As seen from the description made so far, according to the invention, when information is distributed, a distribution history is recorded and the recorded histories are analyzed, whereby distribution information of the information distribution route, distribution range, distribution amount, etc., can be traced later. Tracing in a wider range is enabled by recording not only distribution histories, but also information preparation and use histories. Since the invention can be used to locate the information distribution route and distribution range, the distributor and distribution route of illegal information can be located, for example. The invention can be applied to distribution of all digitalized information such as texts, images, voice, and programs.

## Claims

### 1. An information tracing system comprising:

distribution sensing means for sensing information distribution from a first information processing system as an information distribution source to a second information processing system as an information distribution destination;

a plurality of distribution history storing means for storing histories related to information distribution sensed by said distribution sensing means;

history acquiring means for acquiring the histories stored in other distribution history storing means in response to the history stored in one of said distribution history storing means; and  
analyzing means for analyzing an information distribution route in response to the histories acquired by said history acquiring means.

### 2. An information tracing system as claimed in claim 1, wherein when information is sent from the first information processing system, said distribution sensing means senses the information sending to sense information distribution.

### 3. An information tracing system as claimed in claim 1, wherein when information is received at the second information processing system, said distribution sensing means senses the information recep-

tion to sense information distribution.

4. An information tracing system as claimed in claim 1, wherein when information is sent from the first information processing system, said distribution sensing means senses the information sending, and when information is received at the second information processing system, said distribution sensing means senses the information reception, to sense information distribution.
5. An information tracing system as claimed in claim 1 further comprising:

editing means for editing information;  
edit sensing means for sensing edit executed by said editing means; and  
edit history storing means for storing histories related to edit sensed by said edit sensing means;  
wherein said history acquiring means acquires the histories stored in said distribution history storing means and the histories stored in said edit history storing means; and  
said analyzing means analyzes a distribution route and information change in response to the histories acquired by said history acquiring means.

6. An information tracing system as claimed in claim 1, wherein the distributed information contains an information label which is a label for the information; and

said distribution history storing means stores the information label as a history related to distribution.

7. An information tracing system as claimed in claim 1, wherein said second information processing system further comprising:

information label preparing means being responsive to distributed information for preparing an information label which is a label for the information;  
wherein said distribution history storing means stores the information label prepared by said information label preparing means as a history related to distribution.

8. An information tracing system as claimed in claim 1, wherein when information stored on an information recording medium is distributed, said distribution sensing means senses the information distribution, and wherein

said distribution history storing means stores a history related to the information together with the information and a medium label which is a label for

the storage medium on the information recording medium.

9. An information tracing system as claimed in claim 8, wherein said distribution history storing means stores a history related to the information together with the information and a medium label which is a label for the storage medium on the information recording medium and stores the history related to the information and the medium label which is the label for the storage medium on a storage in said second information processing system to which the information is distributed.

10. An information tracing system as claimed in claim 9 further comprising distribution information notifying means for sending a history from a distribution destination to a distribution source after said distribution sensing means senses information distribution from the information storage medium.

11. An information tracing method comprising the steps of:

sensing information distribution from a first information processing system as an information distribution source to a second information processing system as an information distribution destination;  
storing a history related to the sensed information distribution in a storage of said second information processing system;  
in response to the history stored on the storage in said second information processing system, acquiring the histories stored on storage in other information processing systems; and  
analyzing an information distribution route in response to the acquired histories.

FIG. 1

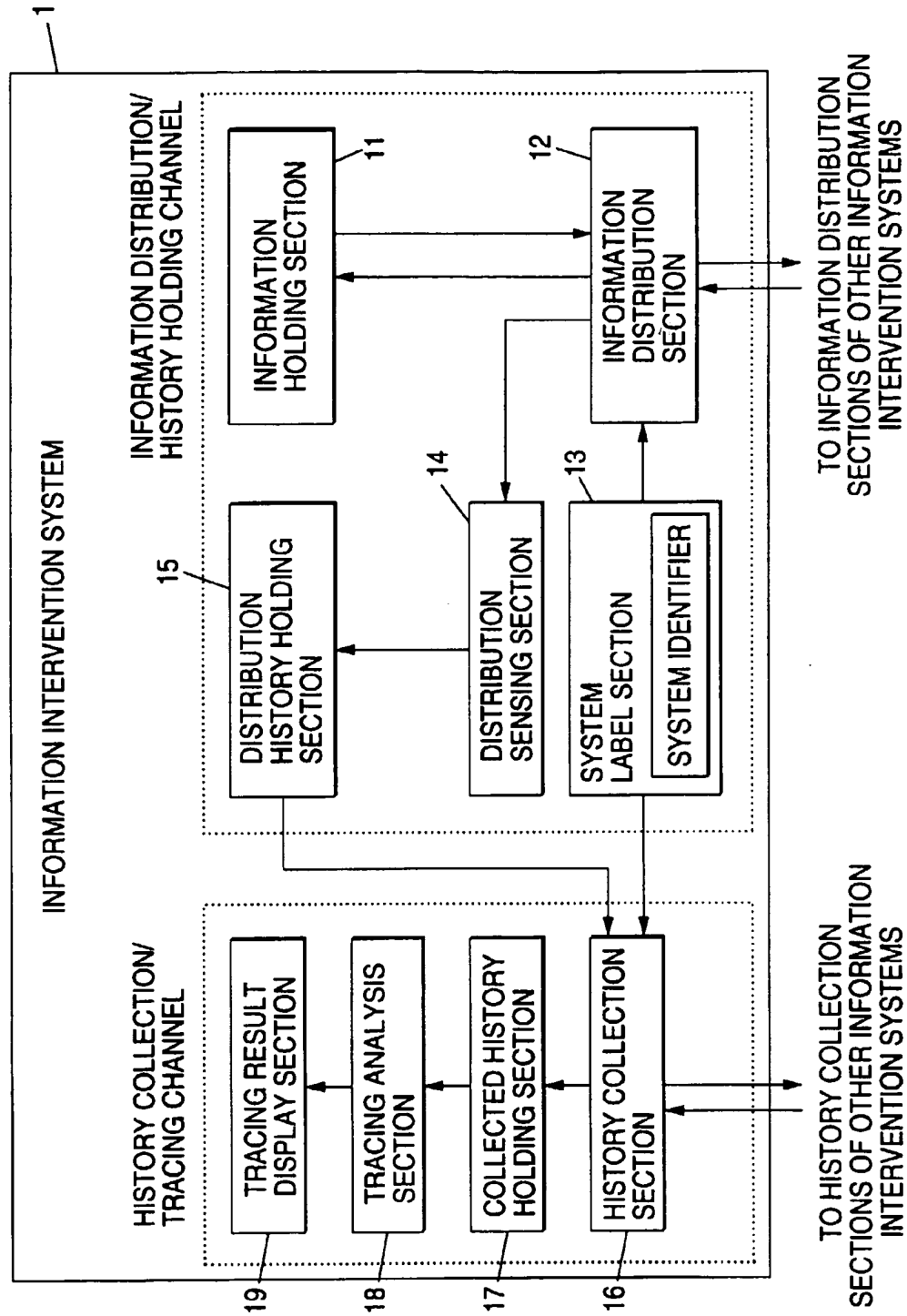


FIG. 2

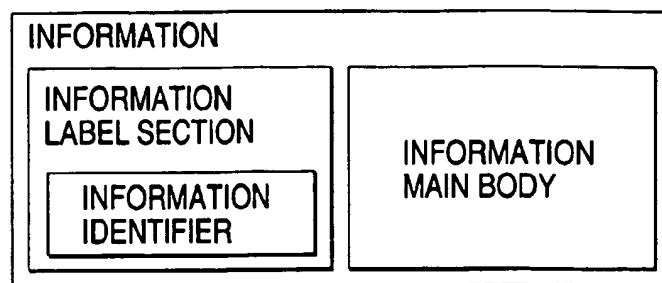


FIG. 3

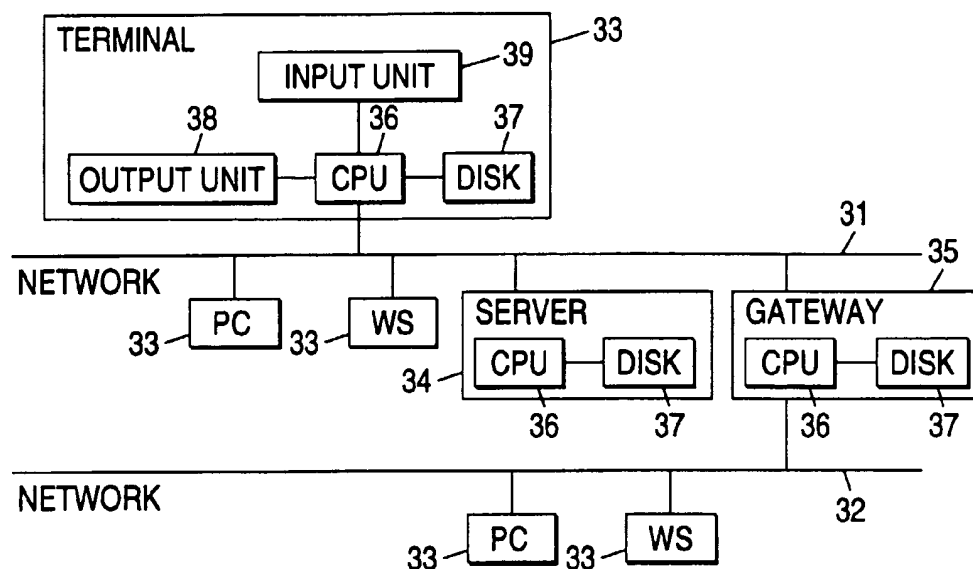


FIG. 4

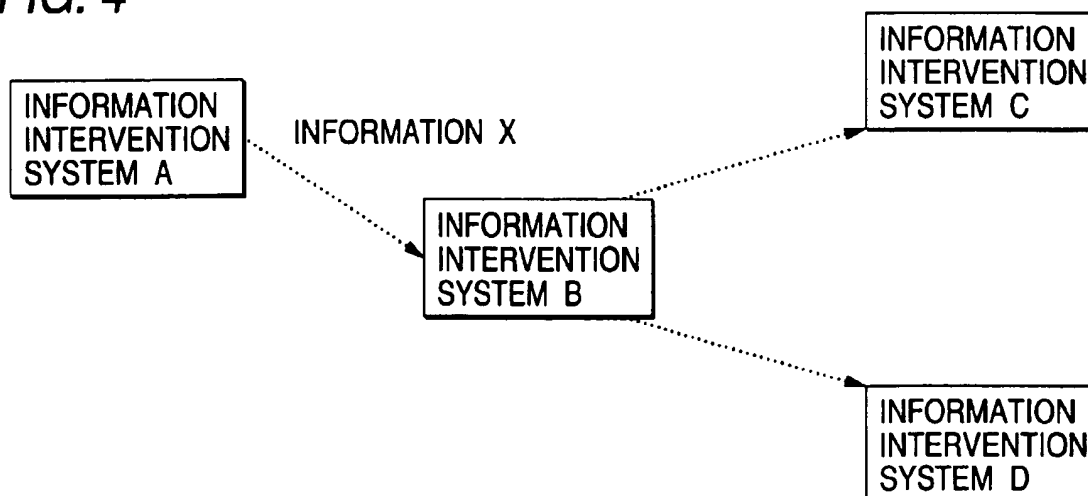


FIG. 5

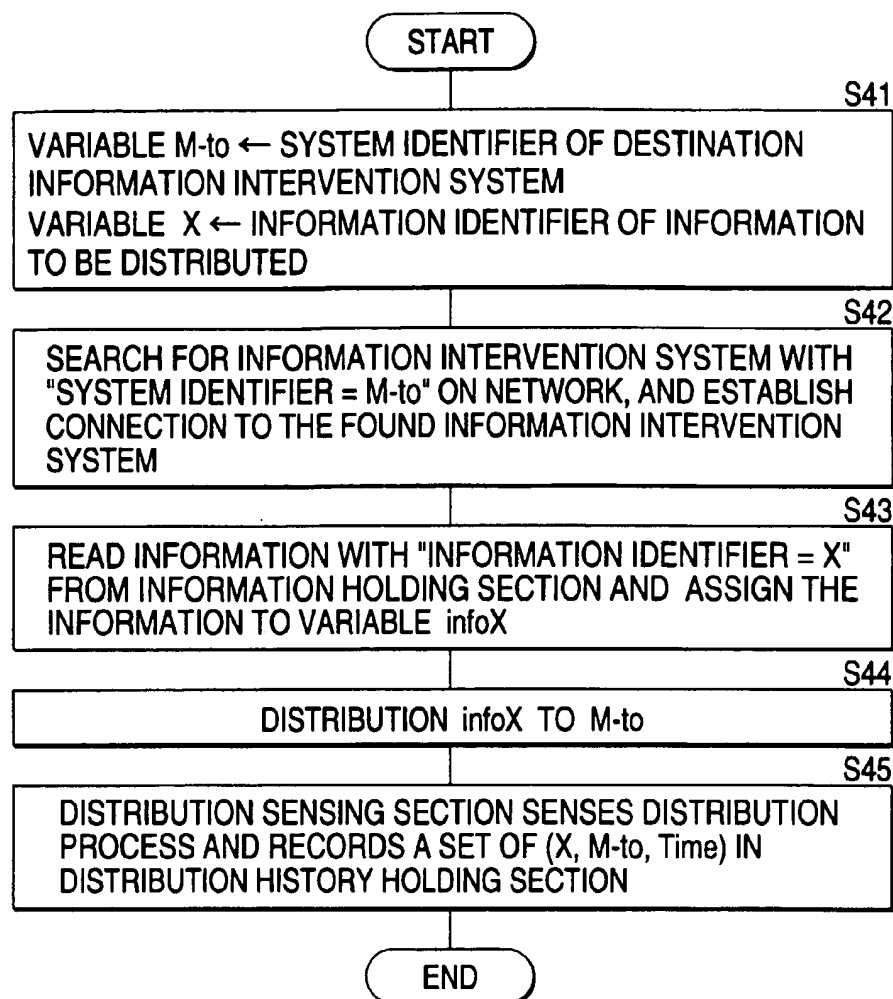


FIG. 6

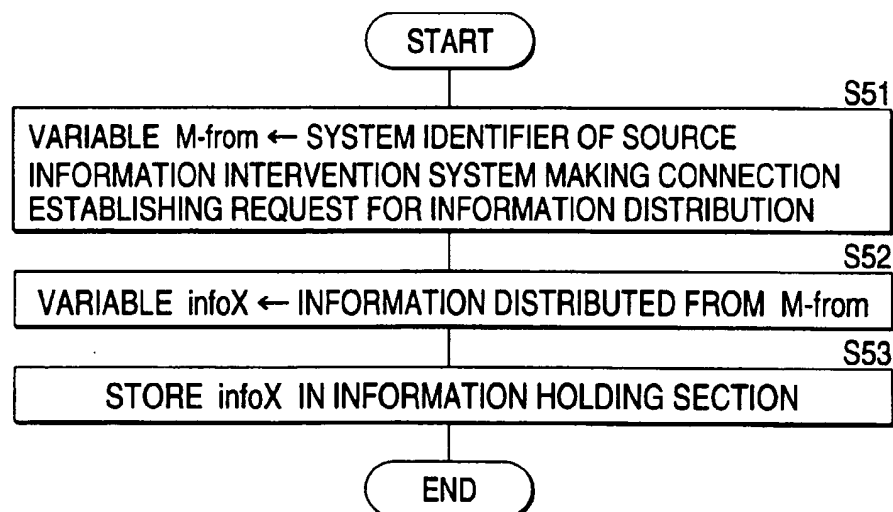
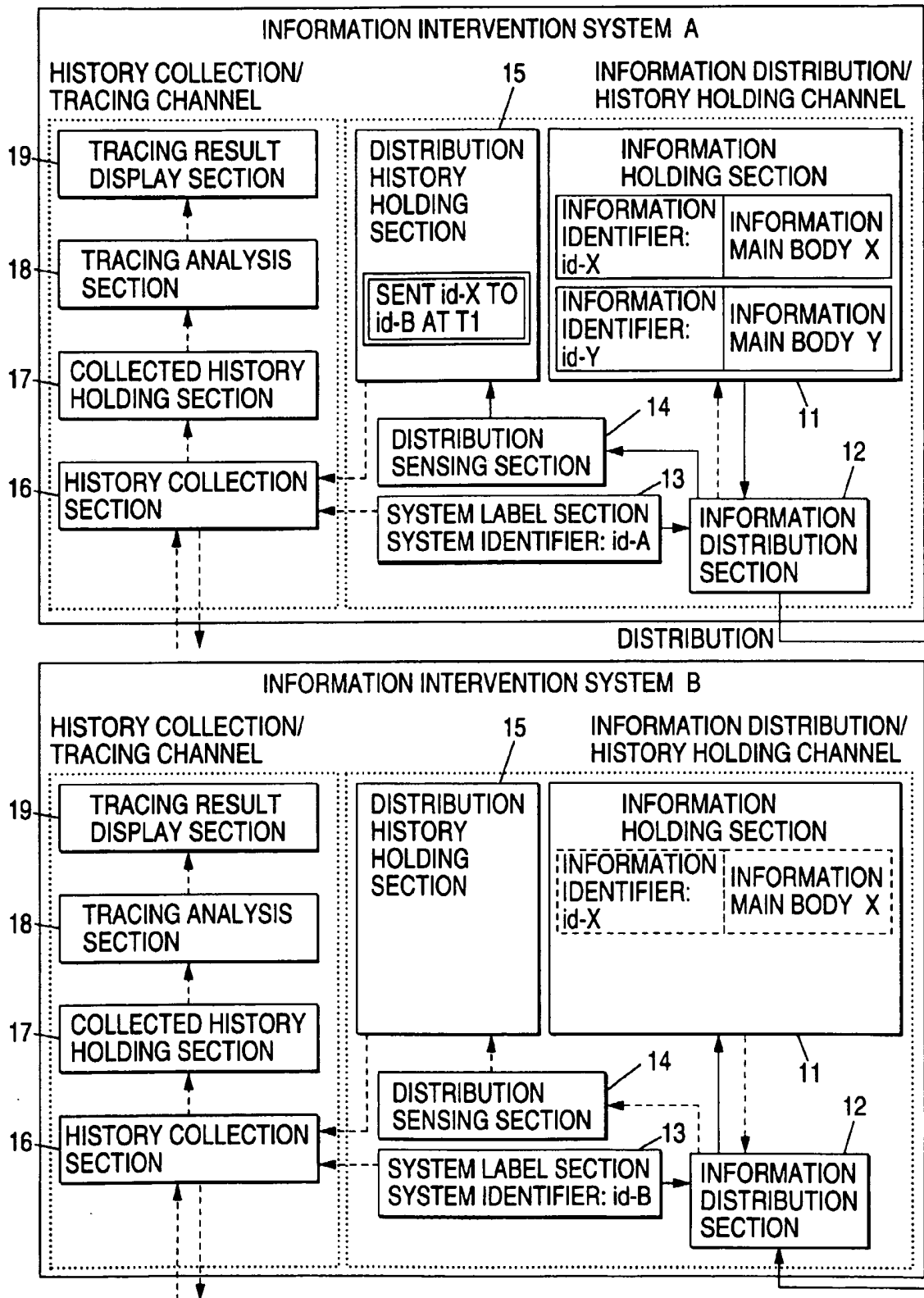


FIG. 7



*FIG. 8*

TARGET INFORMATION IDENTIFIER (12 BYTES)	DESTINATION SYSTEM IDENTIFIER (8 BYTES)	DISTRIBUTION TIME (7 BYTES)
679840-176	800287	1995031012090441
-	-	-
-	-	-



FIG. 9

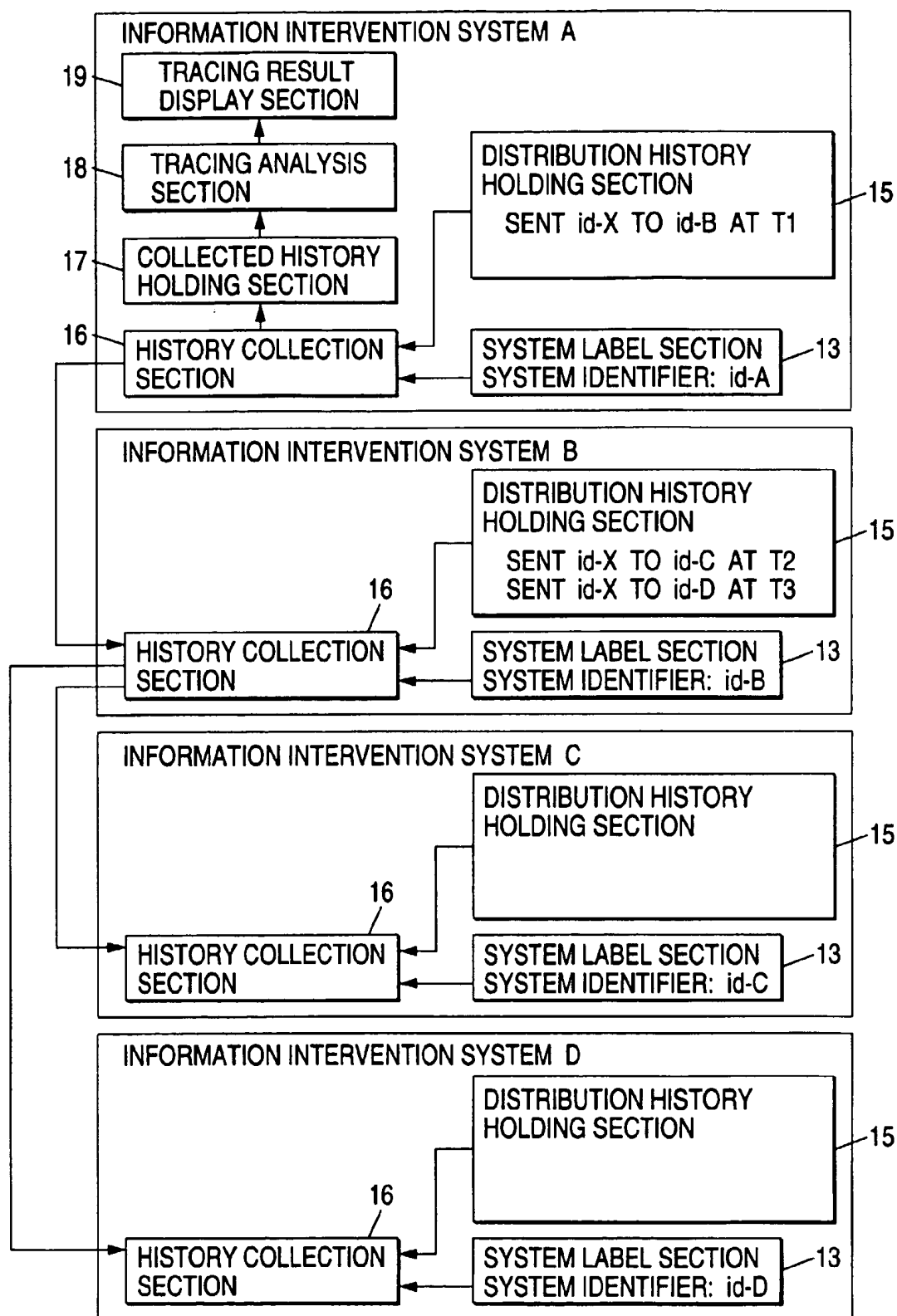


FIG. 10

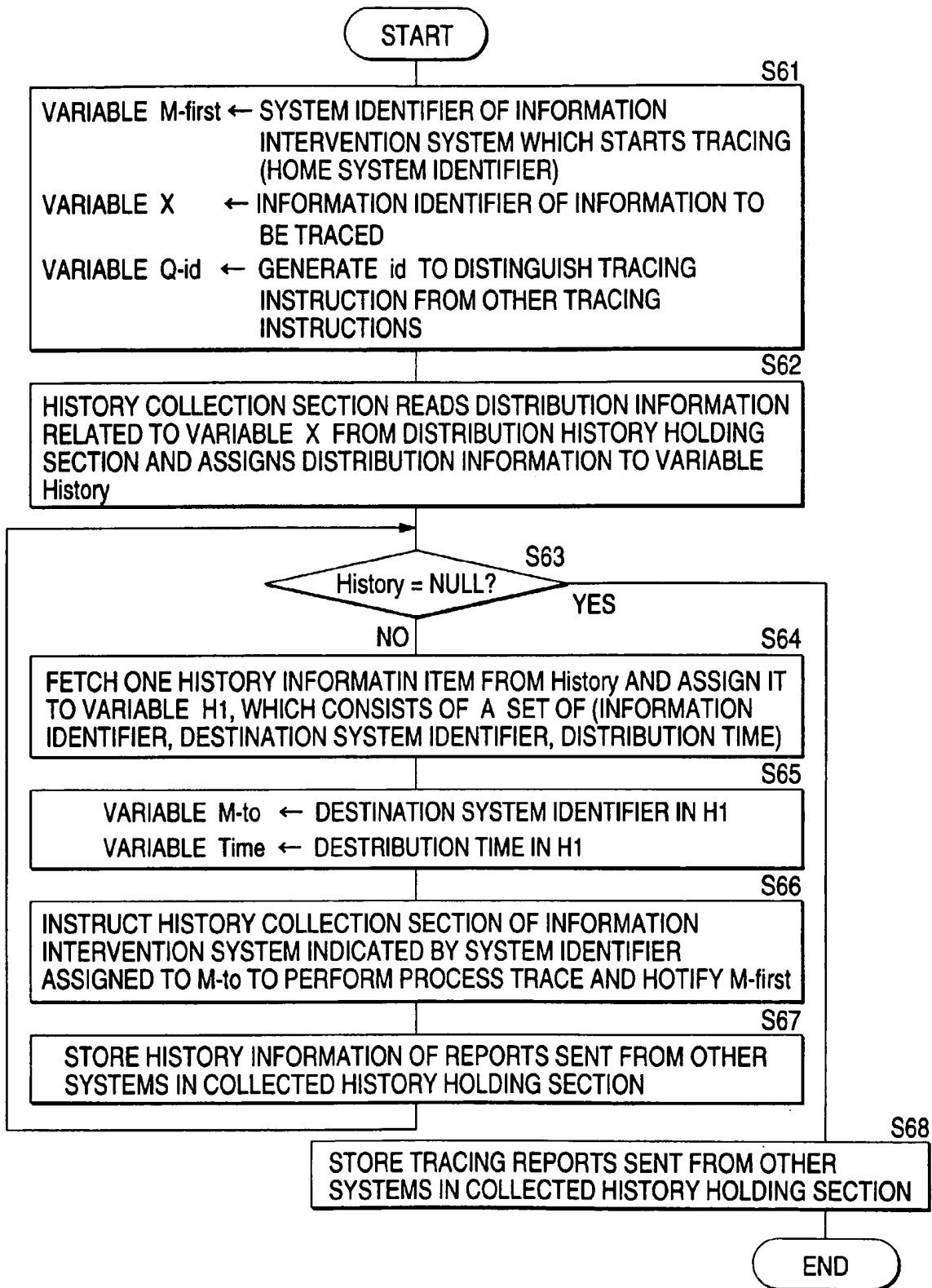


FIG. 11

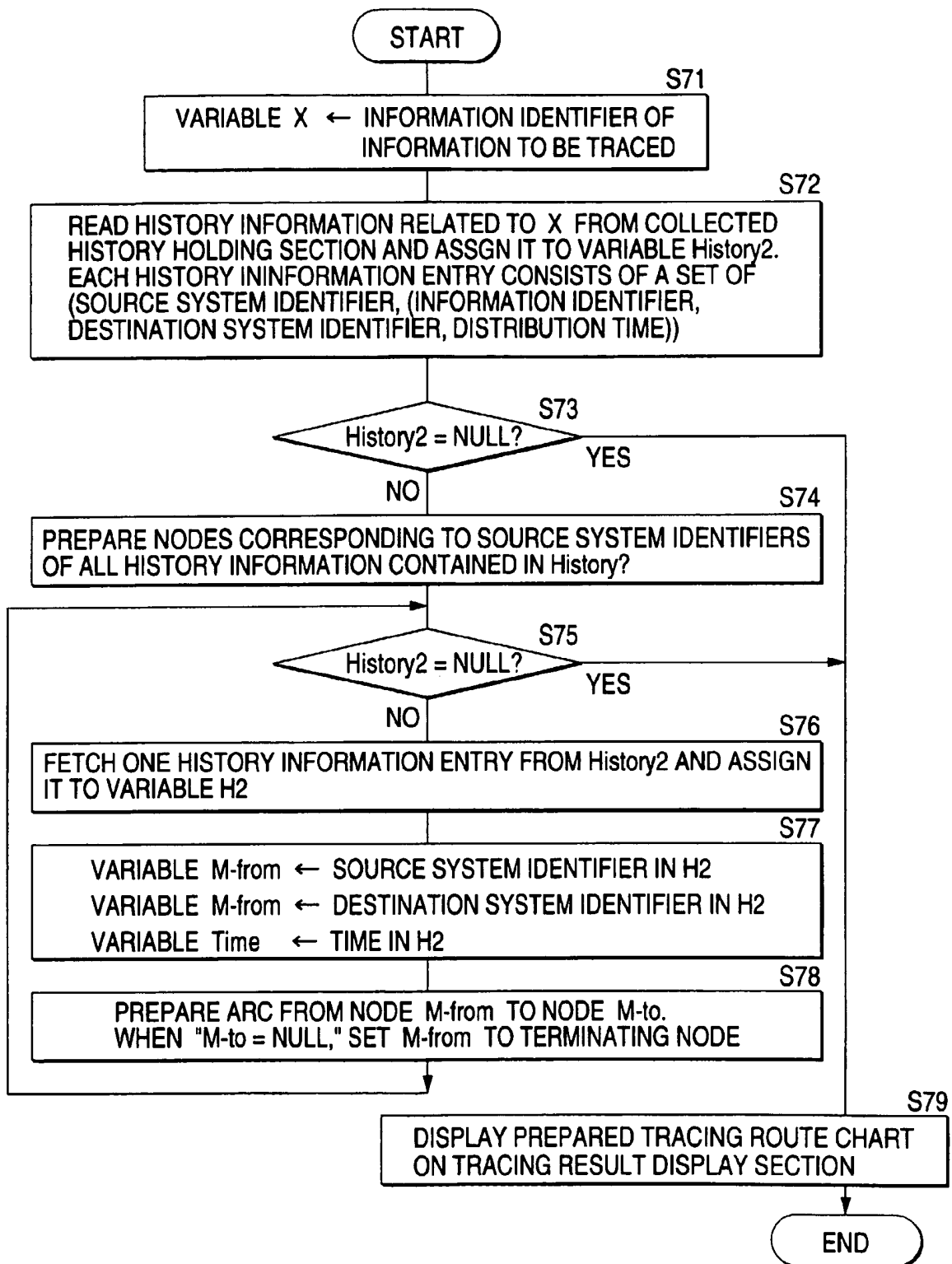


FIG. 12

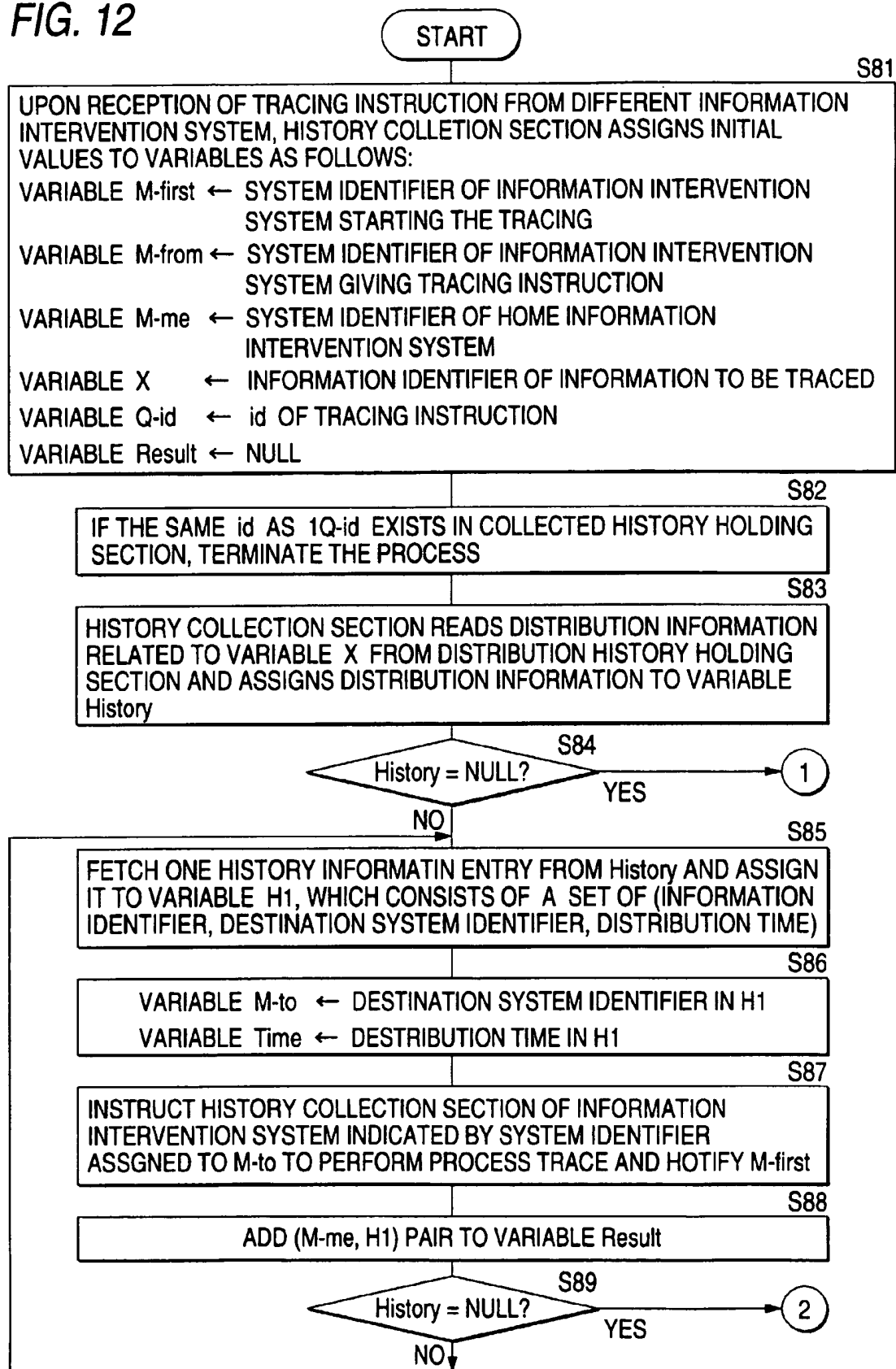


FIG. 13

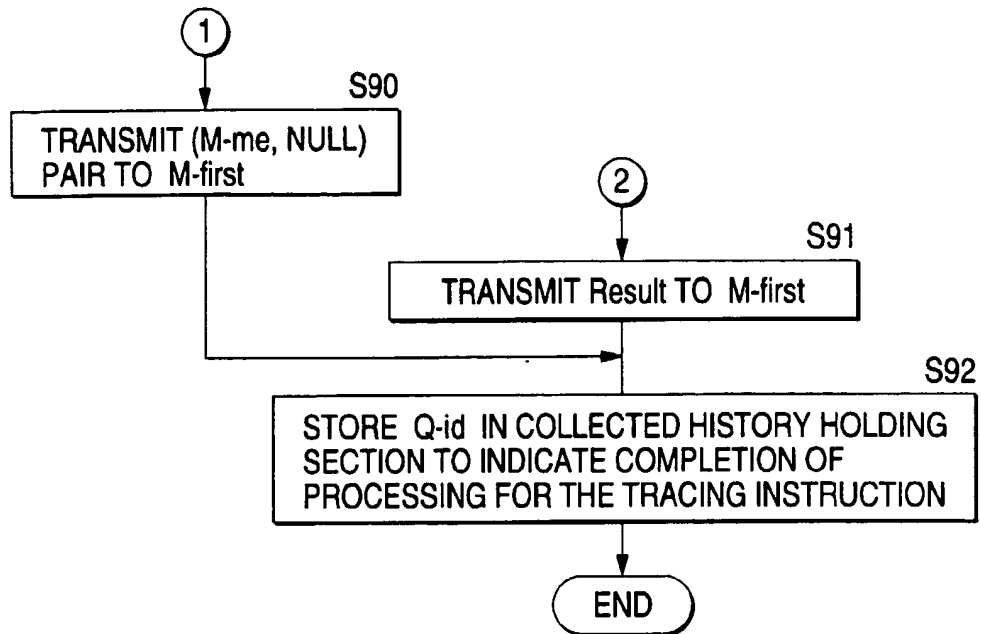


FIG. 14

SOURCE SYSTEM IDENTIFIER (8 BYTES)	TARGET INFORMATION IDENTIFIER (12 BYTES)	DESTINATION SYSTEM IDENTIFIER (8 BYTES)	DISTRIBUTION TIME (7 BYTES)
679840	679840-176	800287	1995031012090441
800287	679840-176	028765	1995031322233489
800287	679840-176	380987	1995031417455534
028765	...	...	...
380987	...	...	...

FIG. 15

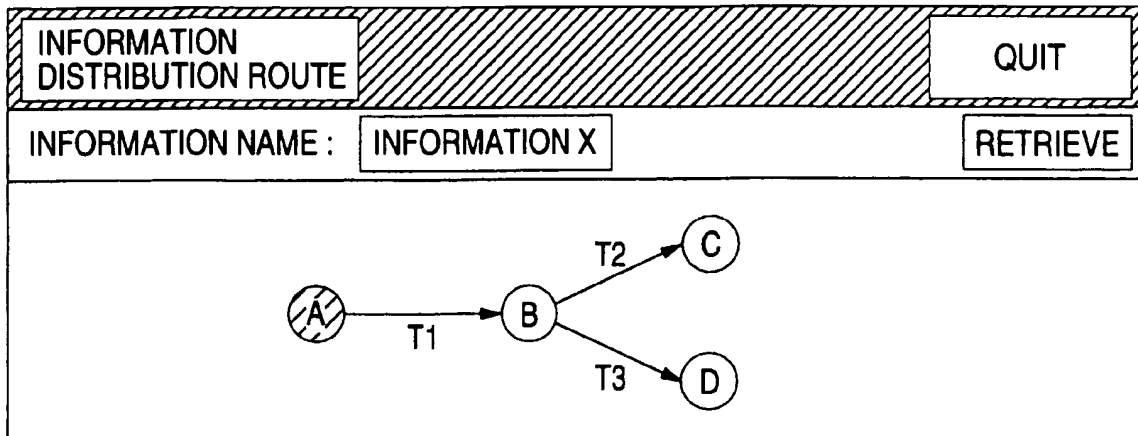


FIG. 16

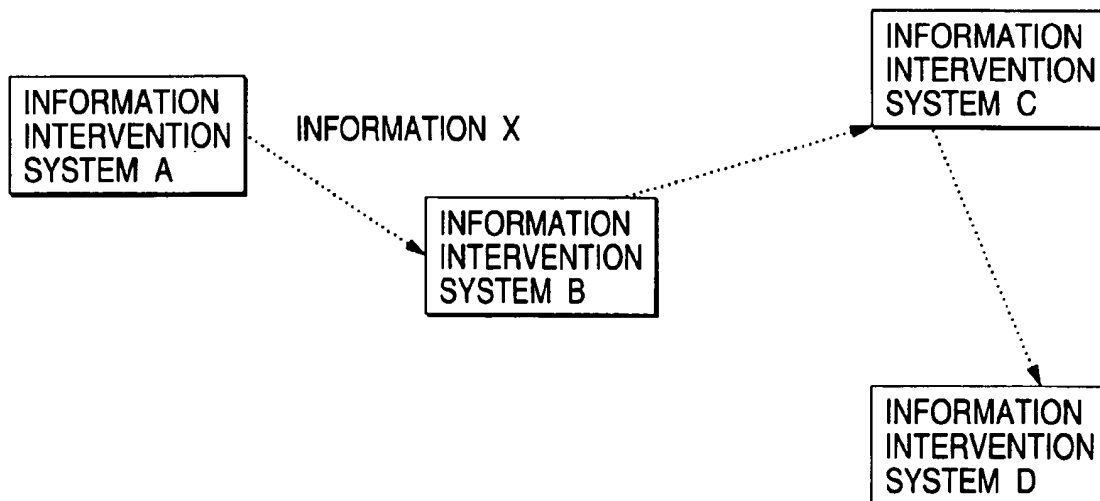


FIG. 17

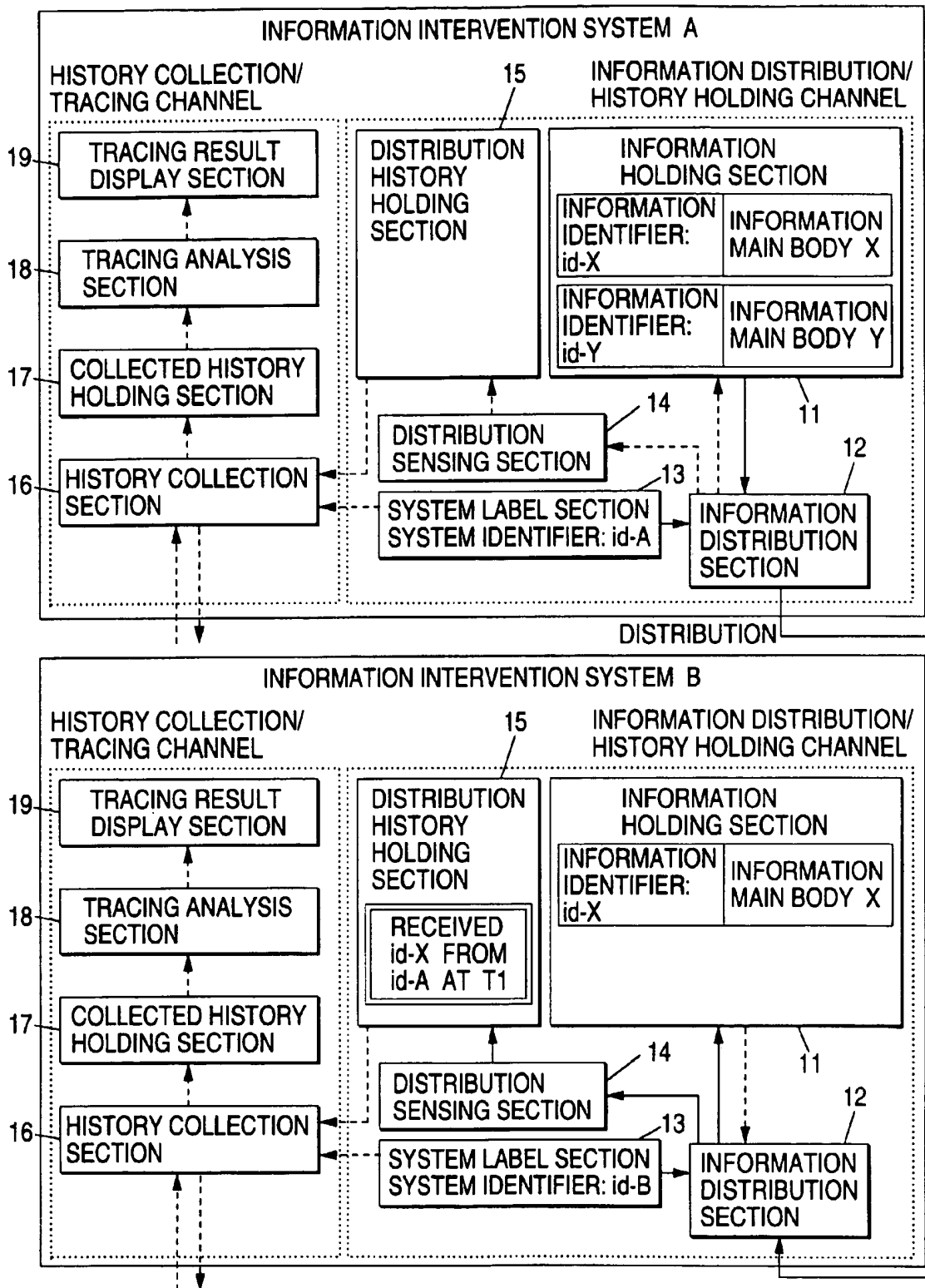


FIG. 18

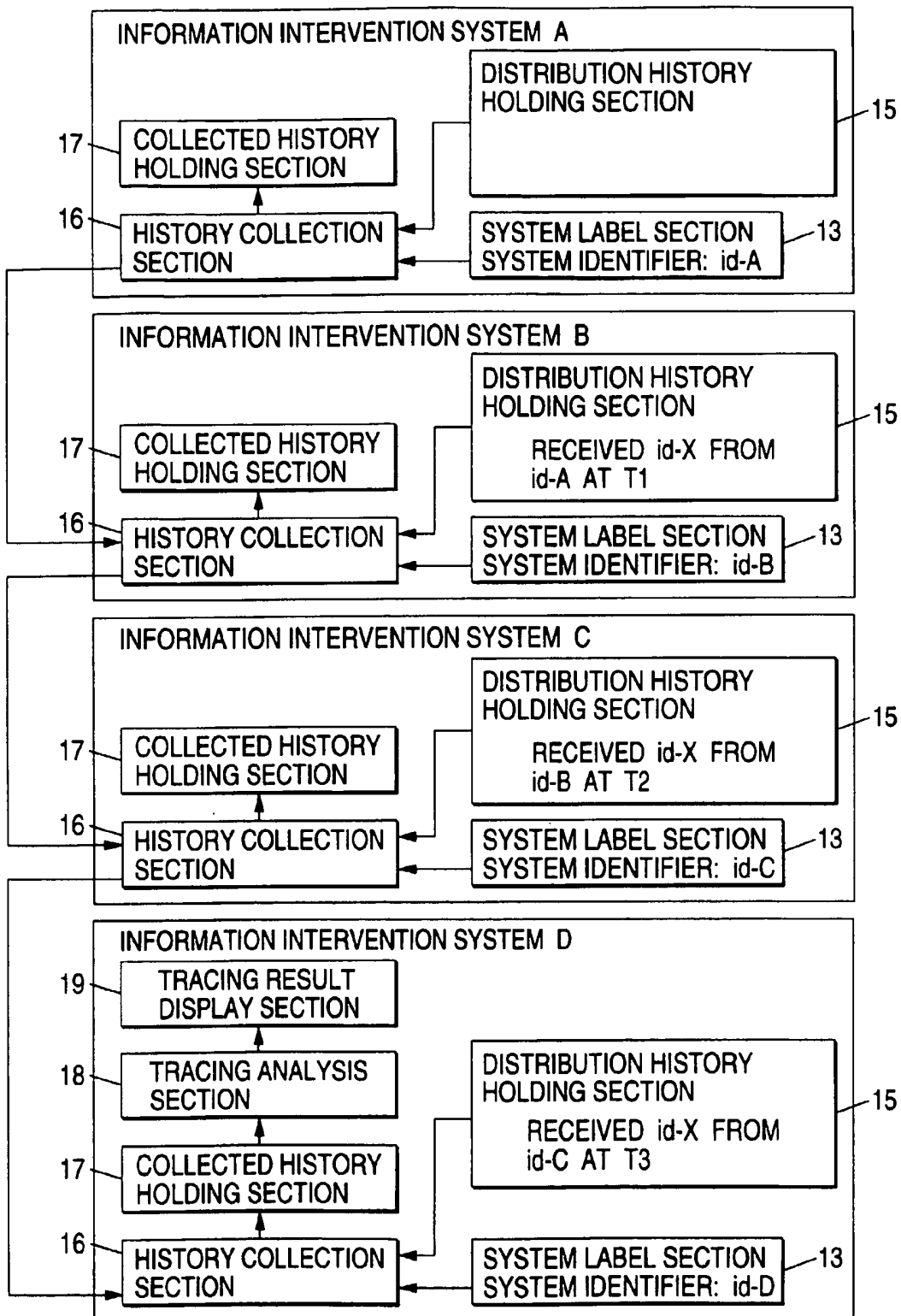




FIG. 19

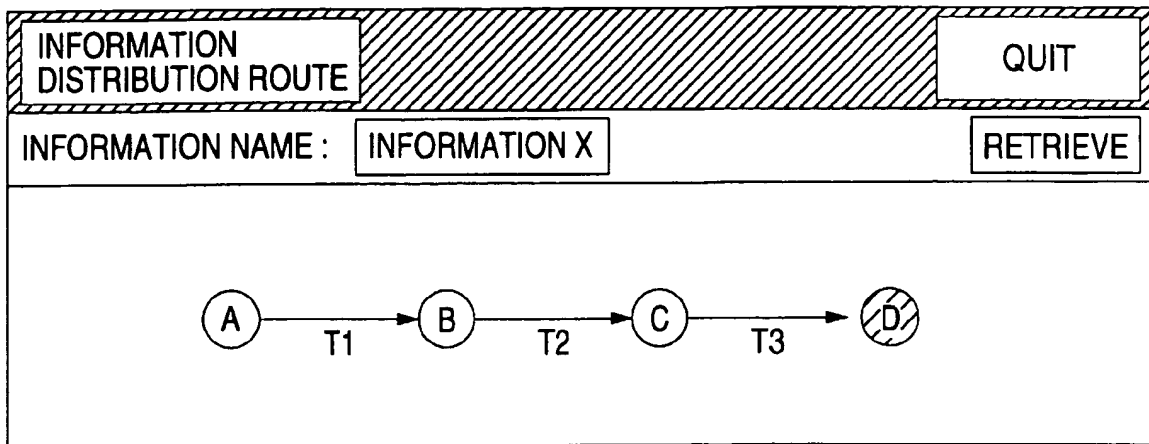


FIG. 20

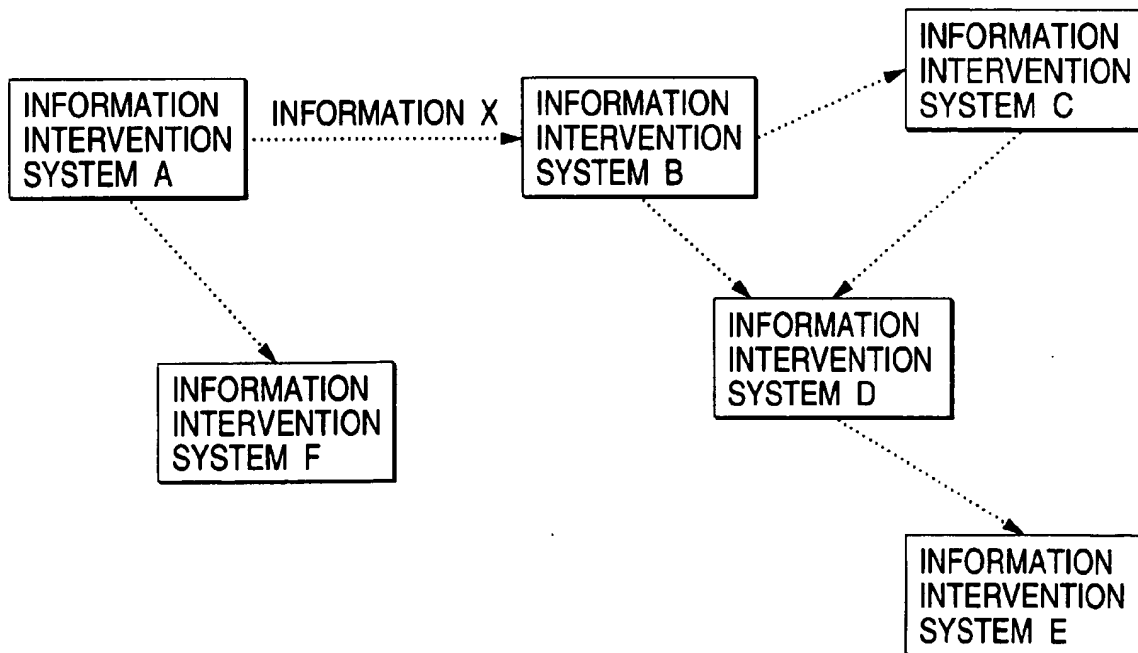


FIG. 21

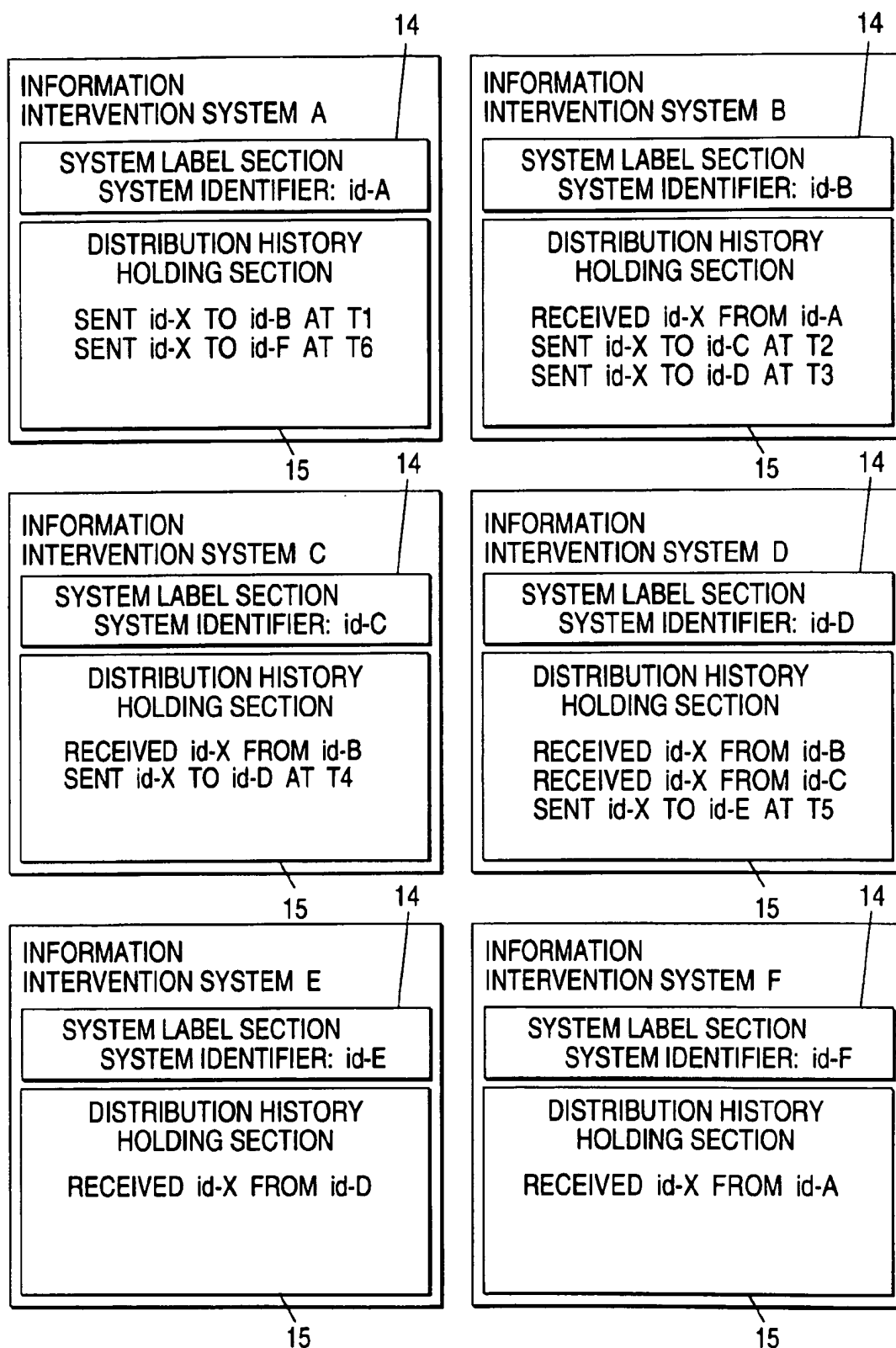


FIG. 22

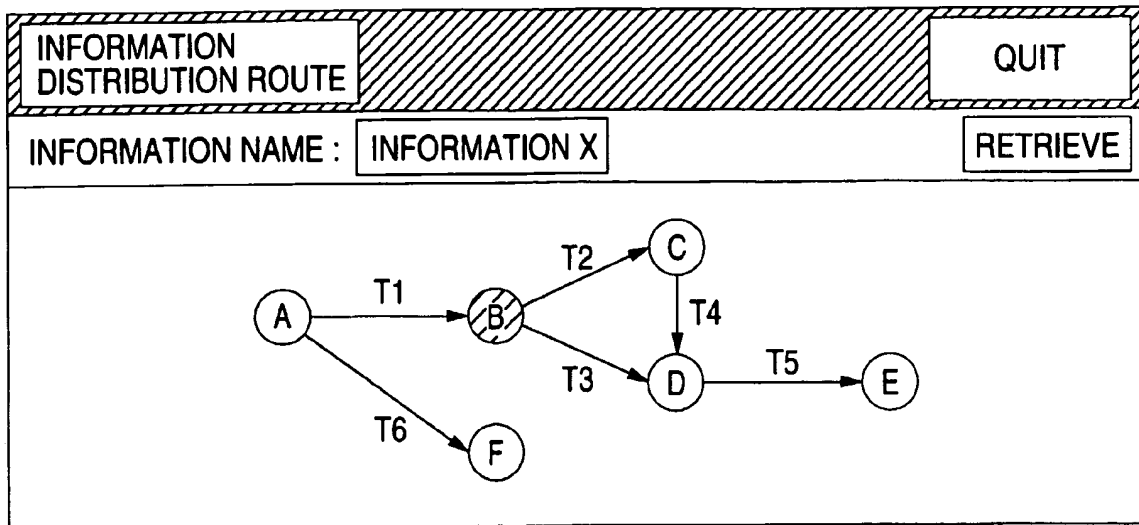


FIG. 24

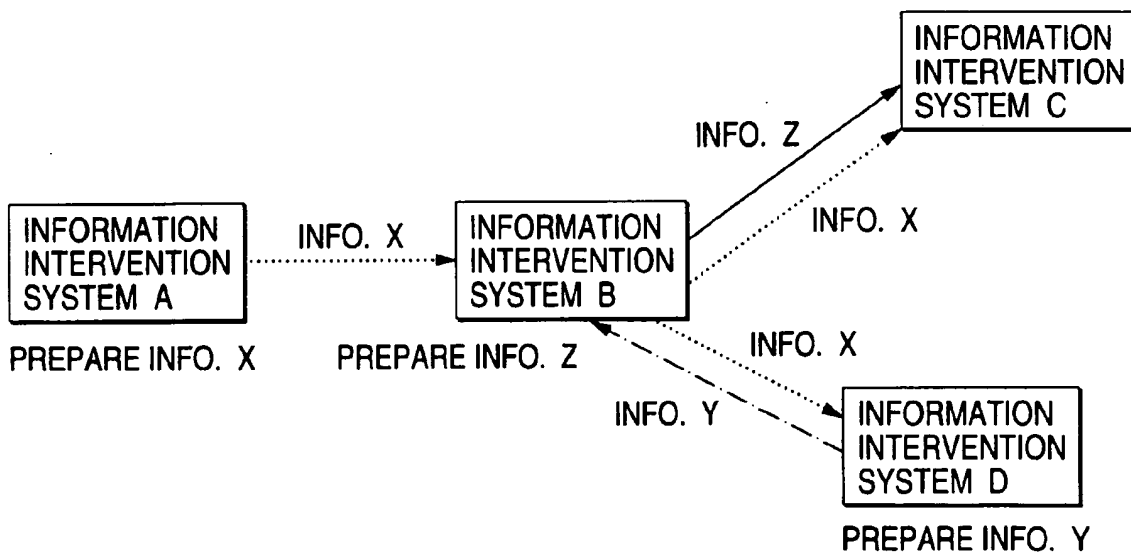


FIG. 23

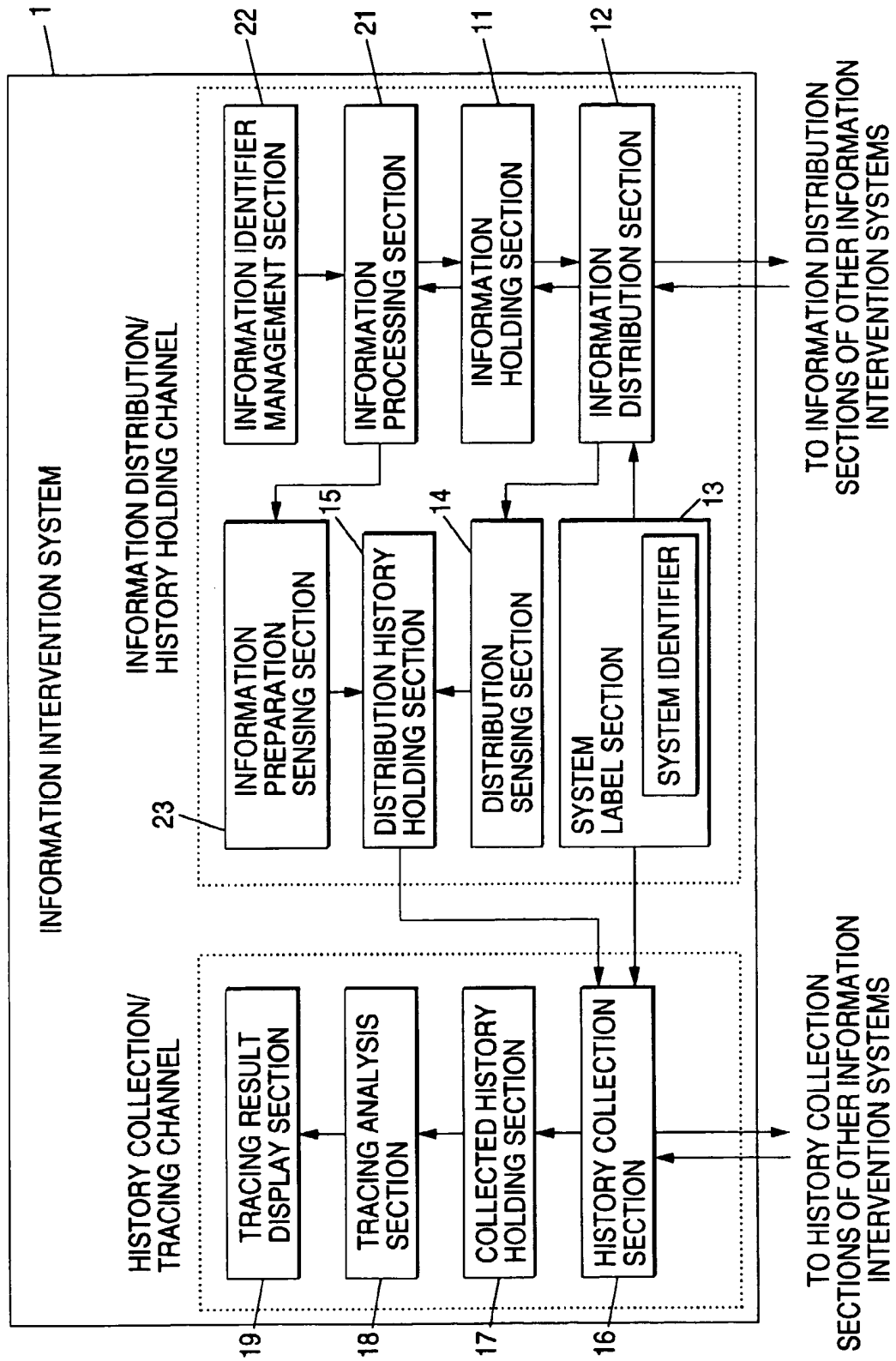


FIG. 25

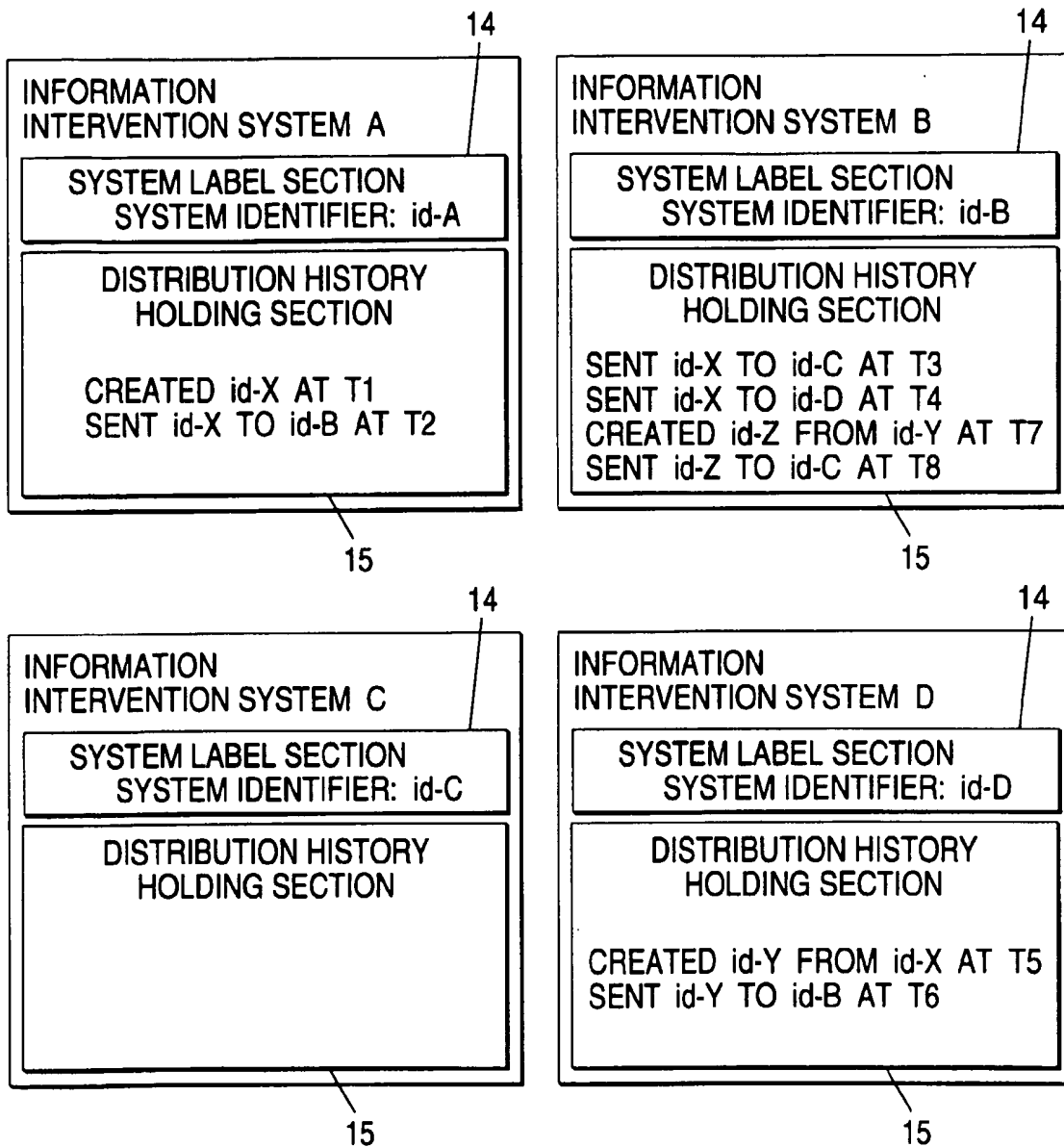


FIG. 26

COLLECTION SOURCE SYSTEM IDENTIFIER (8 BYTES)	OPERATION TYPE (6 BYTES)	TARGET INFORMATION IDENTIFIER (12 BYTES)	ORIGINAL INFORMATION IDENTIFIER (12 BYTES)	DESTINATION SYSTEM IDENTIFIER (8 BYTES)	TIME (7 BYTES)
679840	CREATE	679840-176	NULL	-	1995031012090441
679840	SEND	679840-176	-	800287	1995031322233489
800287	SEND	679840-176	-	028765	1995031417455534
800287	SEND	679840-176	-	380987	1995031513282543
800287	CREATE	800287-123	380987-015	-	1995032015232111
800287	SEND	800287-123	-	028765	1995032018214533
028765	-	-	-	-	-
380987	CREATE	380987-015	679840-176	-	1995031709354213
380987	SEND	380987-015	-	800287	1995031710283456

FIG. 27

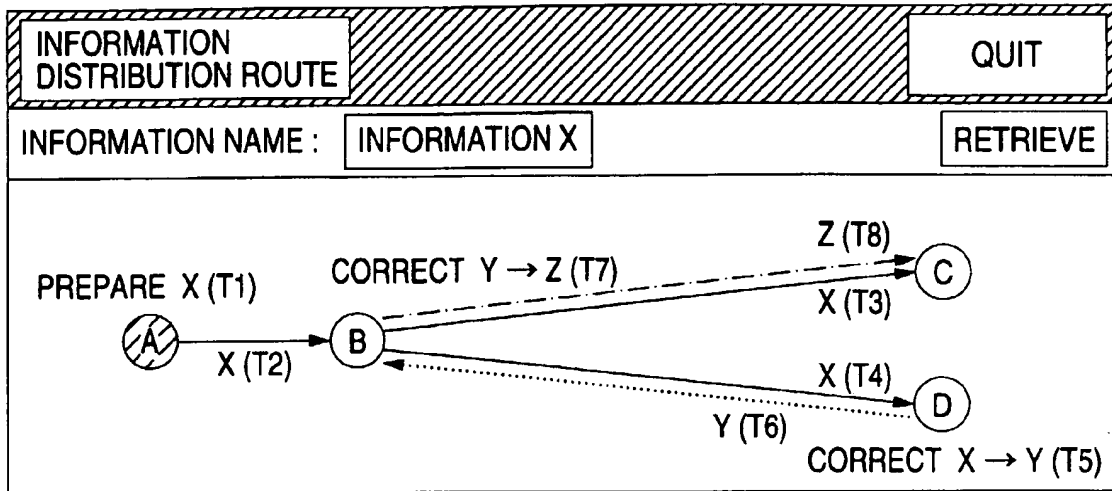


FIG. 28

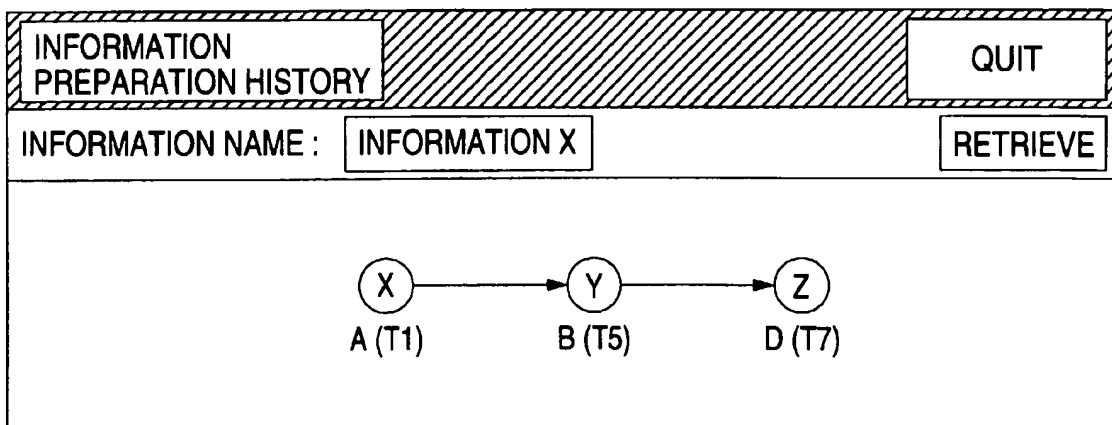


FIG. 29

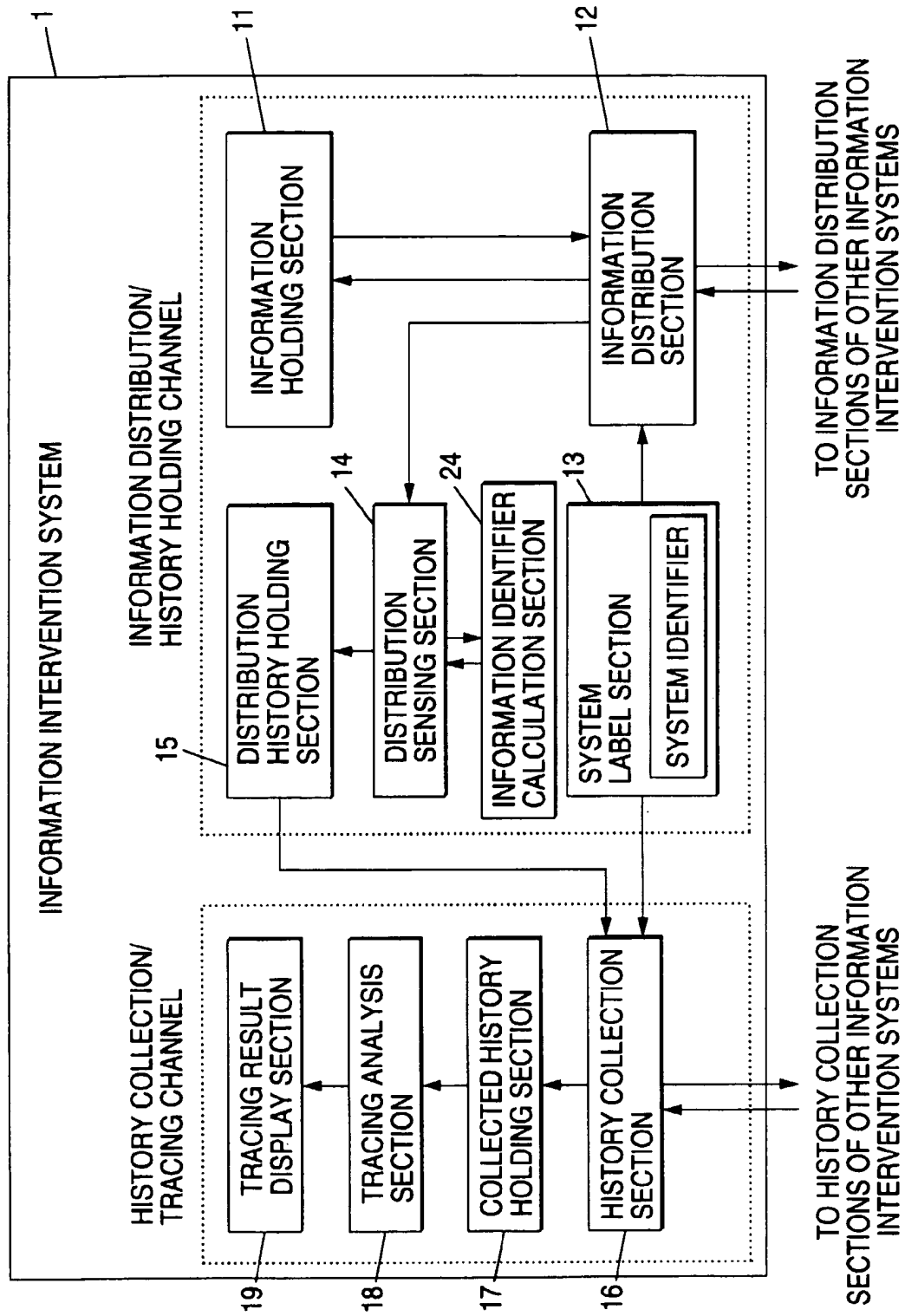




FIG. 30

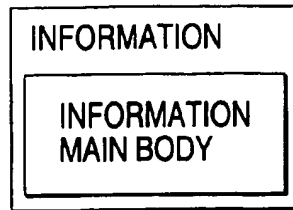


FIG. 32

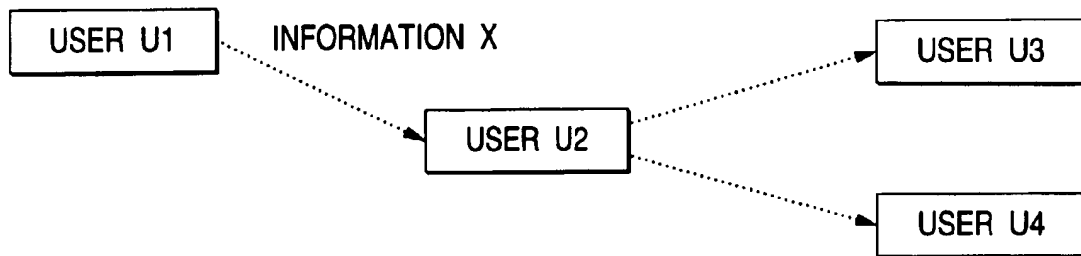


FIG. 33

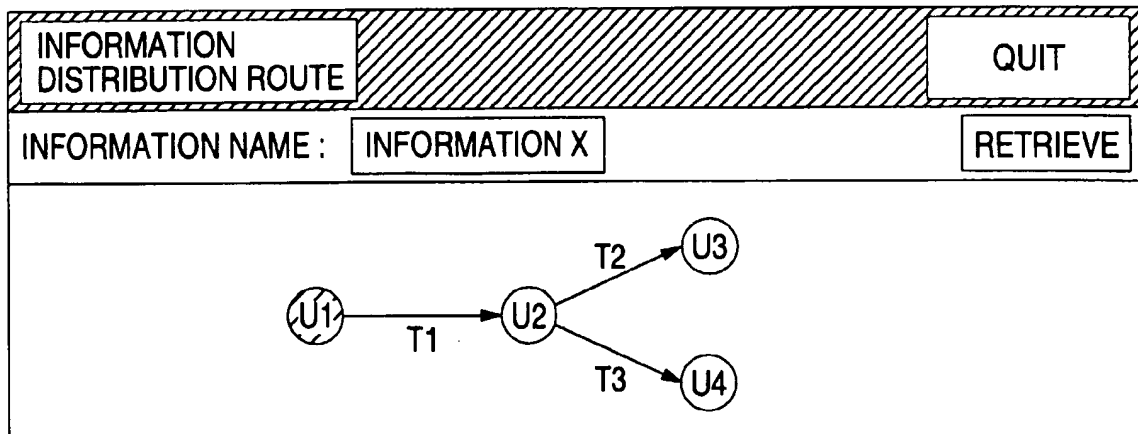
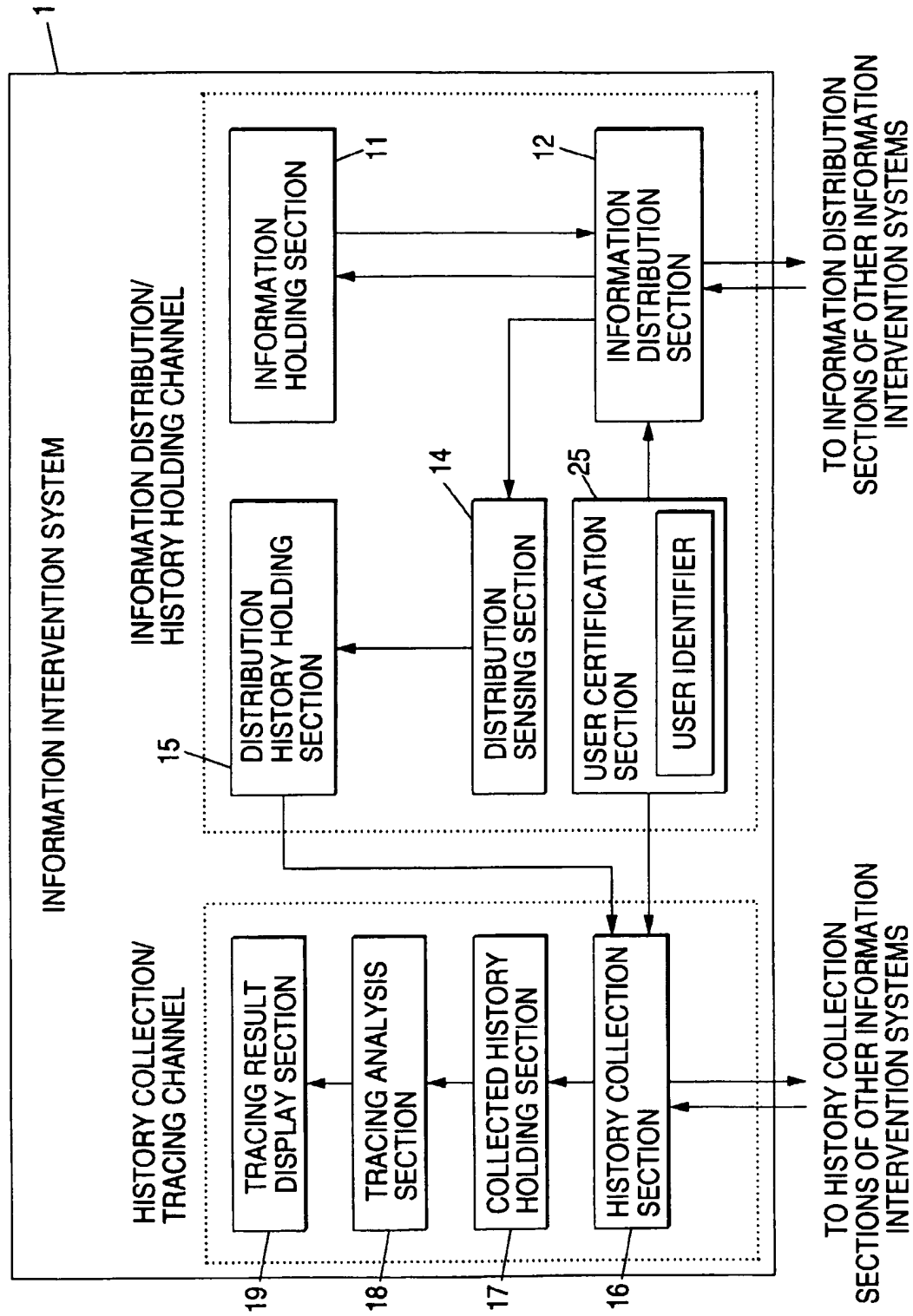
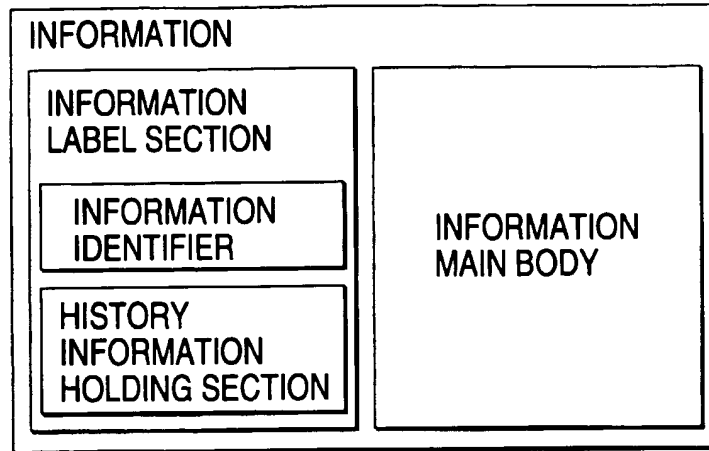


FIG. 31



**FIG. 34**



**FIG. 36**

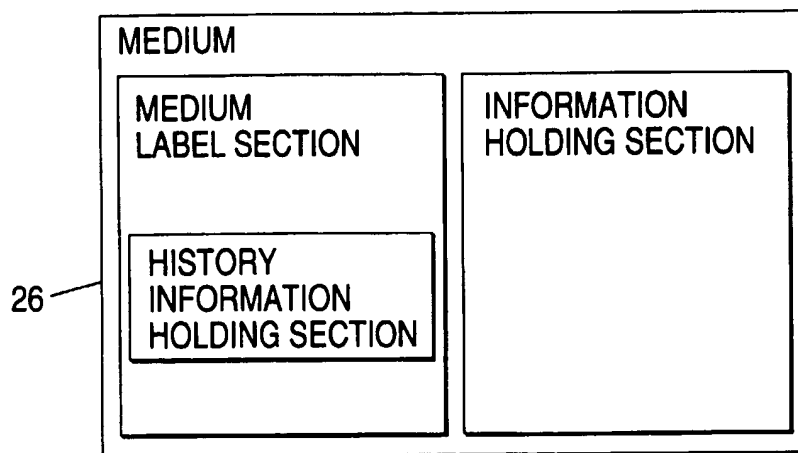


FIG. 35

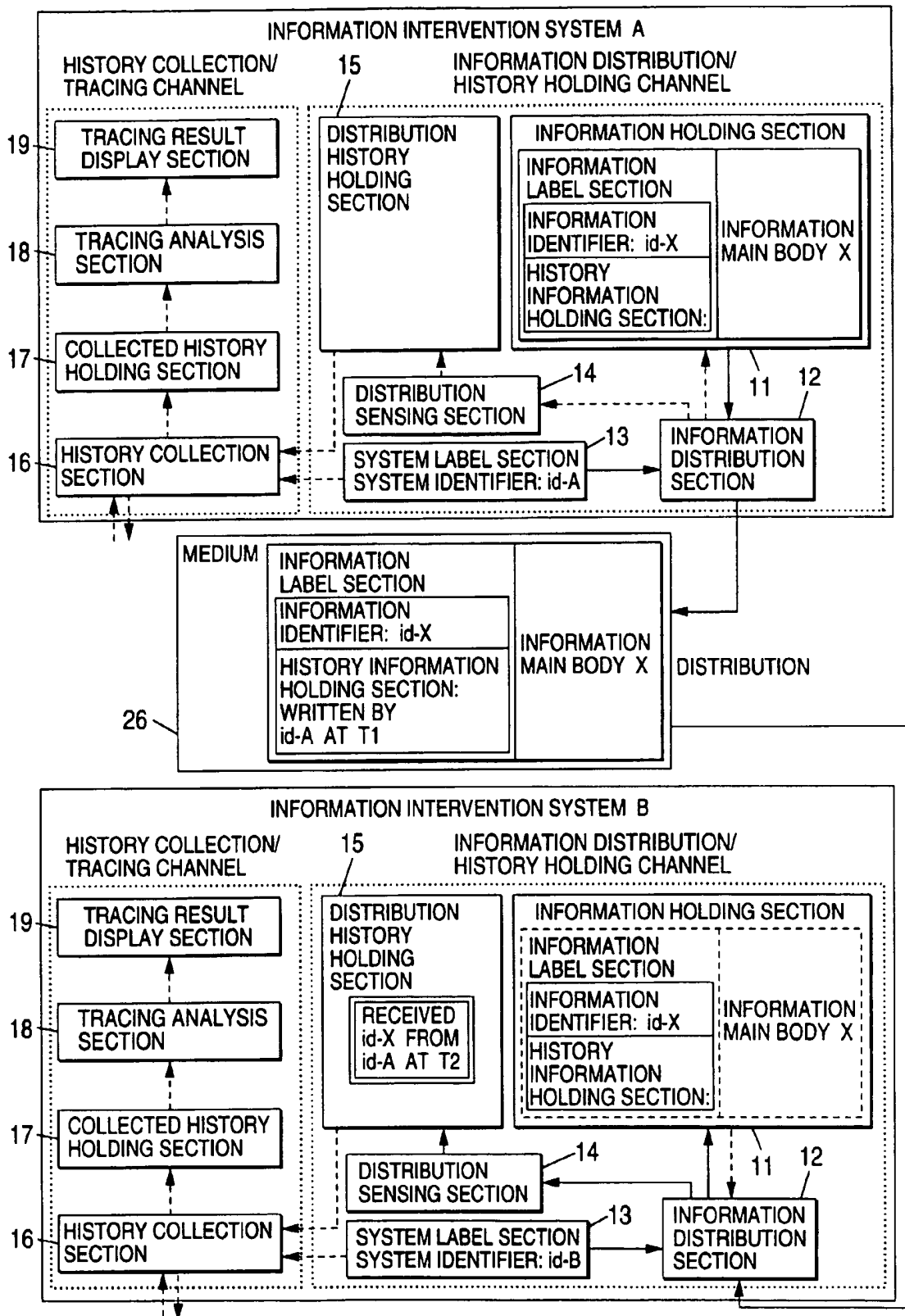


FIG. 37

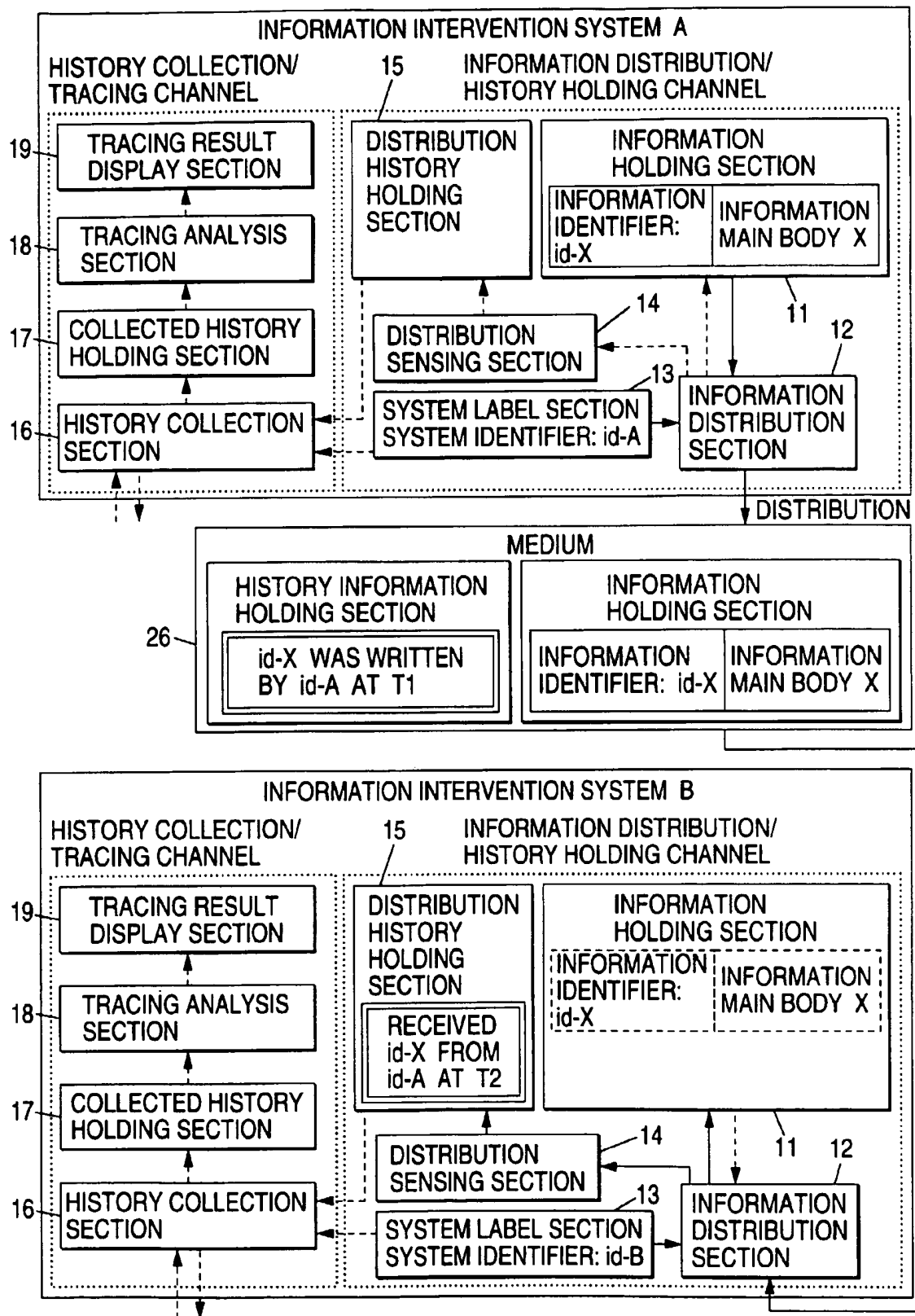


FIG. 38

